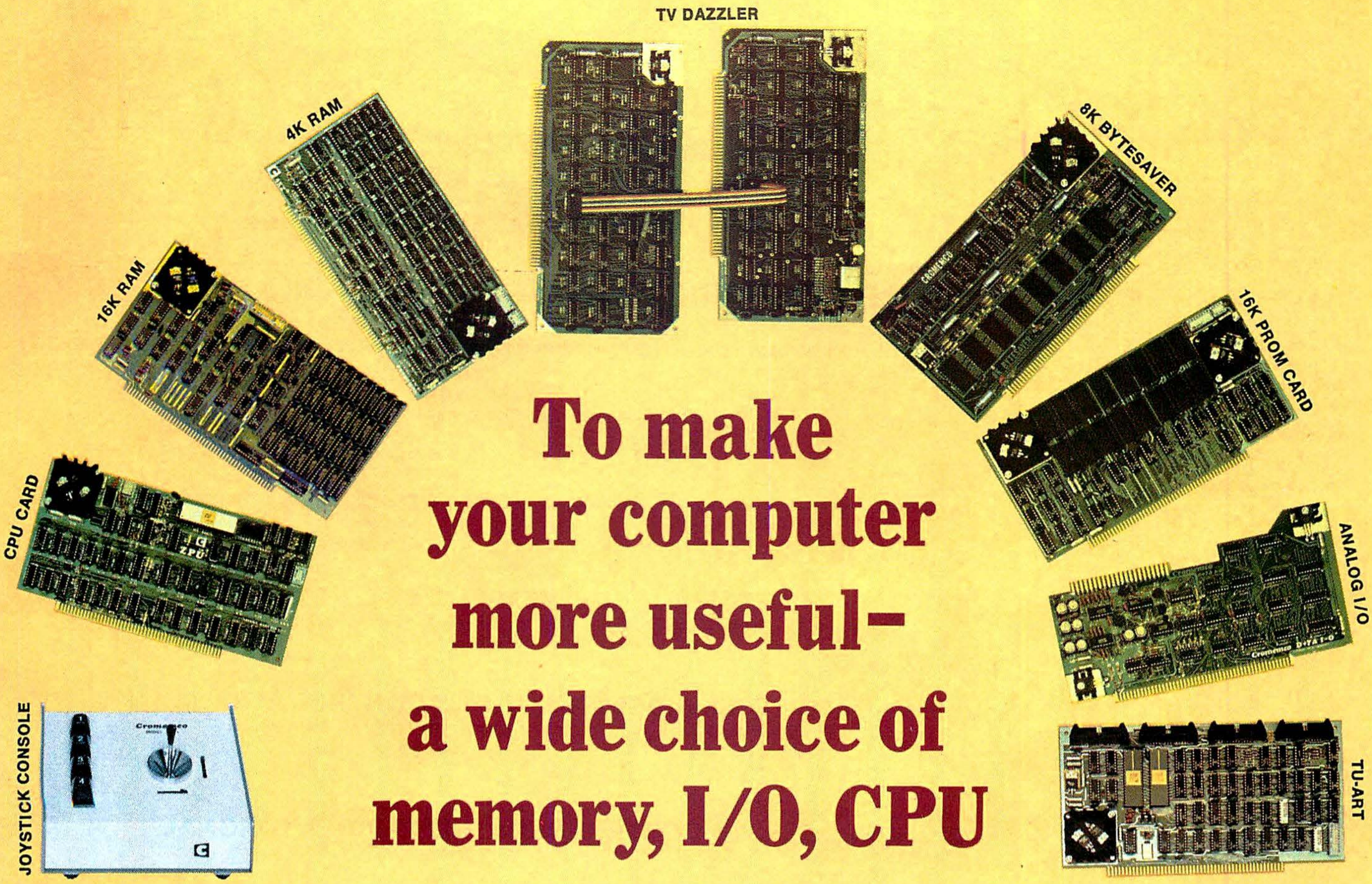
INTERFACE AGE

MICROCOMPUTING FOR HOME AND SMALL BUSINESS VOL. 2, ISSUE 7, JUNE 1977 $1.75

Hexapod
General Payroll Package
Microprogrammed Computers

BIONICS ISSUE



To make your computer more useful– a wide choice of memory, I/O, CPU

Your computer's usefulness depends on the capability of its CPU, memories, and I/O interfaces, right?

So here's a broad line of truly useful computer products that lets you do interesting things with your Cromemco Z-1 and Z-2 computers. And with your S-100-compatible Altairs and IMSAIs, too.

CPU

- Z-80 MICROPROCESSOR CARD. The most advanced μP card available. Forms the heart of our Z-1 and Z-2 systems. Also a direct replacement for Altair/IMSAI CPUs. Has 4-MHz clock rate and the power of the Z-80 μP chip. Kit (Model ZPU-K): $295. Assembled (Model ZPU-W): $395.

MEMORIES

- 16K RAM. The fastest available. Also has bank-select feature. Kit (Model 16KZ-K): $495. Assembled (Model 16KZ-W): $795.
- 4K RAM. Bank-select allows expansion to 8 banks of 64K bytes each. Kit (Model 4KZ-K): $195. Assembled (Model 4KZ-W): $295.
- THE BYTESAVER — an 8K capacity PROM card *with integral programmer*. Uses high-speed 2708 erasable PROMs. A must for all computers. Will load 8K BASIC into RAM in less than a second. Kit (Model BSK-0): $145. Assembled (Model BSW-0): $245.
- 16K CAPACITY PROM CARD. Capacity for up to 16K of high-speed 2708 erasable PROM. Kit (Model 16KPR-K): $145. Assembled (Model 16KPR-W): $245.

I/O INTERFACES

- FAST 7-CHANNEL DIGITAL-ANALOG I/O. Extremely useful board with 7 A/D channels and 7 D/A channels. Also one 8-bit parallel I/O channel. Kit (Model D + 7A-K): $145. Assembled (Model D + 7A-W): $245.
- TV DAZZLER. Color graphics interface. Lets you use color TV as full-color graphics terminal. Kit (Model CGI-K): $215. Assembled (Model CGI-W): $350.
- DIGITAL INTERFACE (OUR NEW TU-ART). Interfaces with teletype, CRT terminals, line printers, etc. Has not one but *two serial I/O ports* and *two 8-bit parallel I/O ports* as well as 10 on-board interval timers. Kit (Model TRT-K): $195. Assembled (Model TRT-W): $295.
- JOYSTICK. A console that lets you input physical position data with above Model D + 7 A/D card. For games, process control, etc. Contains speaker for sound effects. Kit (Model JS-1-K): $65. Assembled (Model JS-1-W): $95.

PROFESSIONAL QUALITY

You get first-class quality with Cromemco.

Here are actual quotes from articles by independent experts: "The Cromemco boards are absolutely beautiful" . . . "The BYTESAVER is tremendous" . . . "Construction of Cromemco I/O and joystick are outstanding" . . . "Cromemco peripherals ran with no trouble whatsoever."

Everyone agrees. Cromemco is tops.

STORES/MAIL

So count on Cromemco. Look into these Cromemco products at your store. Or order by mail from the factory.

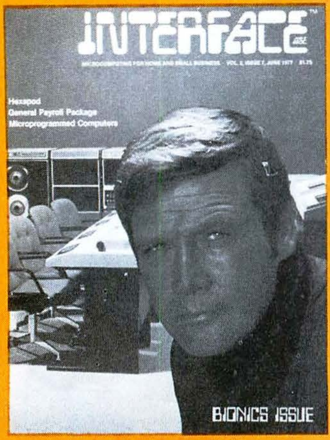
We wish you pleasure and success with your computer.

Cromemco
incorporated
Specialists in computers and peripherals
2432 CHARLESTON RD., MOUNTAIN VIEW, CA 94043 • (415) 964-7400

INTERFACE AGE™

MICROCOMPUTING FOR HOME AND THE SMALL BUSINESSMAN

Bionics Special



COVER STORY

Our cover reflects the existing reality that today's dreams turn into tomorrow's fact. As the dividing line between fact and fiction narrows each day, semiconductor technology and large-scale computer concepts are merged.

Integrating people and the microprocessor truly becomes exciting when Medical Science and determination team up.

Pictured are Lee Majors from the popular ABC T.V. series "The Six Million Dollar Man" and a Digital Equipment Corporation PDP 11-45 computer.

Our sincere thanks and appreciation to ABC T.V. and Universal Studios for their co-operation in making our cover possible.

Special thanks also go to Data Processing Design, Inc. of Buena Park, California for providing the background and setting.

Advertising Index 144
Book Review 94
FIFO Flea Market 142
From the Fountainhead ... 12
Hardware Section 66
Interfacial 4
Letters to the Editor 5
Micro-Market 140
New Products 82
Sense Line 6
Software Section 123
Update and Calendar 8

FEATURES

BIONICS — THE SCIENCE YOU WEAR 15
AN EDITORIAL — *by Linda Folkard-Stengel, Associate Editor*

A MICROCOMPUTER-AIDED PROSTHESIS CONTROL SYSTEM 16
A STUDY OF PROGRAMMED AUTONOMOUS AND ADAPTIVE SEMI-AUTONOMOUS SYSTEMS — *by Amos Freedy, John Lyman and Moshe Solomonow*

MICROPROCESSOR CONTROL PROSTHESIS VIA EMG SIGNAL 24
COMING CLOSER TO *THINKING* DIRECTLY INTO THE COMPUTER — *by Daniel Graupe*

HEXAPOD 29
NATURE AND TECHNOLOGY TOOK DIFFERENT APPROACHES TO LOCOMOTION. NOW THEY ARE CONVERGING — *by Robert B. McGhee and James R. Buckett*

MICROPROGRAMMED COMPUTERS 56
AN EXPLANATION OF THE WILKES METHOD OF PROGRAMMING — *by Oliver Holt*

HARDWARE FEATURE

INTRODUCING THE S-100 STANDARD SMALL COMPUTER BUS STRUCTURE 66
by W. M. Goble

SOFTWARE FEATURE

GENERAL PAYROLL PACKAGE 96
EVERYONE LIKES PAYDAY— — *by Bud Shamburger*

SOFTWARE EDITORIAL 123
by Robert A. Stevens, Software Editor

DAY OF THE WEEK 128
by Jim Huffman

STAR LANES 131
by Steven Faber

INTERFACE AGE Magazine, published monthly by McPheters, Wolfe & Jones, 13913 Artesia Blvd., Cerritos, Calif. 90701. Subscription rates: U.S. $10.00, Canada/Mexico $12.00, all other countries $18.00. Opinions expressed in by-lined articles do not necessarily reflect the opinion of this magazine or the publisher. Mention of products by trade name in editorial material or advertisements contained herein in no way constitutes endorsement of the product or products by this magazine or the publisher.

POSTMASTER: Please send change of address form 3579 and undelivered copies to **INTERFACE AGE** Magazine, 13913 Artesia Blvd., Cerritos, Calif. 90701. Second-class postage paid at Artesia, California 90701 and at additional mailing offices.

INTERFACIAL

This month, in presenting our two features: BIONICS and PAYROLL PACKAGE, INTERFACE AGE addresses itself to two segments of our readership, the scientist and the businessman.

Microcomputer technology applied in these two fields exemplifies the adaptable potential of microprocessors. It seems only yesterday that the technology was developed. In a mere "thousand days" it has permeated almost every aspect of the economic, academic and cultural scene.

It is a revolution, but the merriest revolution ever undertaken. The ubiquitous little devices appear to present no threat to the populace. The growth of users' clubs across the nation indicates that microcomputers are now accepted as tools and toys with a passion approaching the North American's penchant for pet husbandry.

And this interest is a potent vitamin pill for the electronics industry. Adam Osborne reports in Fountainhead on two more large companies who are entering the microcomputer market.

* * * *

Our reader mail about the April Robotics Issue was overwhelmingly positive. Many readers encouraged us with letters and phone calls to present a BIONICS Special. Our problem lay in finding the scientists doing the work along these lines. We started with an inquiry to members of the State of California's Governor's Committee for the Handicapped. Soon we were referred to the Veterans Administration.

From the time our staff established telephone contact with the V.A., we were treated with courtesy and diligence. The agency personnel worked unsparingly to supply us with names and project references which enabled us to locate our material. We owe a particular word of thanks to Mr. Carl Mason of the V.A. Bio-Engineering Research Service in New York. He supplied the names of contract-awardees and additionally saw to it that we seldom had to contact the project personnel "cold." When we reached them, he had announced us.

At this time when so many dissentient opinions are voiced towards this agency, we are happy to publish the opposite view.

* * * *

"EVERYBODY LIKES PAYDAY . . " Bud Shamburger explains how payday in his 22-employee motel was a blessing for almost everyone except the accounting staff. Now with the help of a microcomputer system, *everyone* looks forward to payday. Mr. Shamburger shares his cybernetic accomplishment with our readers.

While on the subject of software, we owe our Software Editor, Bob Stevens a word of praise in print. Mr. Stevens not only procures and evaluates all the software published each month, he also maintains the Software Directory as a public service.

We wanted to publish a photo of our Software Editor, but found him reluctant to consent. He might be camera-shy, or he might be unwilling to add his likeness to the lineup of bad portraits we have published in the previous months. That's alright, Bob, as long as you continue to give our readers entertaining games such as STAR LANES.

* * * *

We've stopped the press to report that we've made the Finals in the 1977 MAGGIE AWARDS in the category of Crafts, Hobbies & Pets. The MAGGIE AWARDS are conferred each year to publications in the 14 Western States by the Western Publisher's Association.

INTERFACE AGE MAGAZINE
13913 Artesia Boulevard
Cerritos, CA 90701
(213) 926-6629

PUBLISHER & EDITOR-IN-CHIEF
ROBERT S. JONES

ASSOCIATE EDITOR
LINDA FOLKARD-STENGEL

GENERAL MANAGER
NANCY A. JONES

ASSISTANT MANAGER
EVA YAKA

NORTHWESTERN REGIONAL EDITOR
ADAM OSBORNE, PhD

EDITORIAL CO-ORDINATOR
WILLIAM SEVEDGE

HARDWARE EDITOR
ROGER EDELSON

SOFTWARE EDITOR
ROBERT STEVENS

CONTRIBUTING BUSINESS EDITOR
BUD SHAMBURGER

PRODUCTION LAYOUT EDITOR
MIKE ANTICH

ART
CHARLYNE LEVANDOWSKI

SUBSCRIPTION CIRCULATION
JO ANN FERGUSON

TYPOGRAPHER
MELODY A. MARTENS

Editorial Correspondence
Direct all correspondence to the appropriate editor at: INTERFACE AGE Magazine, P.O. Box 1234, Cerritos, California 90701.

NATIONAL SALES MANAGER
BRUCE BERKEY

ADVERTISING-Representative
STEVE RICHARDS
ZACH BOVINETTE

Advertising Inquiries
Direct all advertising inquiries to: Advertising Department, INTERFACE AGE Magazine, 61 South Lake Avenue, P.O. Box 4566, Pasadena, CA 91106. (213) 795-7002.

DOMESTIC RETAIL CIRCULATION
ZACH BOVINETTE
(213) 795-7002

JAPAN CIRCULATION
KAZUHIKO NISHI
Kougakusha Publishing Co., Ltd., Haneda Bldg. 602 2-5-1 Yoyogi Shibuya, Tokyo, Japan.

UNITED KINGDOM CIRCULATION
VINCENT COEN
L.P. Enterprise, 313 Kingston Road, Ilford, Essex, England IGIIPJ.
01-553-1001

wpa MEMBER OF THE WESTERN PUBLISHERS ASSOCIATION

Letters to the Editor

Dear Editor:

Mind-boggling, thought-inducing and absolutely terrifying. Your article appearing in the April 1977 issue of INTERFACE AGE is absolutely one of the best-written articles I've ever read. The article to which I am referring is "The Remotoid/Android Project." I hope I am writing to the right address for this.

I have always been fascinated by the possibilities of technology and science. Every day we get closer and closer to making a machine equal or even to surpass ourselves. In actuality, how far off are we from the experiences of Colossus or the HAL 9000? Not to plug another magazine, but in Popular Electronics, they presented a construction article to add speech to a home microcomputer. If anything, by simply writing the article appearing in the robotics section of INTERFACE AGE illustrates how fast the future is coming. As a service to INTERFACE readers, it is my opinion that you get this construction into your magazine. It fits into an Altair bus I believe.

In conclusion, I want to say that I am fascinated and intrigued by the articles published in this month on robotics. Bravo! Please continue on this topic if it is at all possible, gentlemen — you have just earned yourselves a subscriber for life!

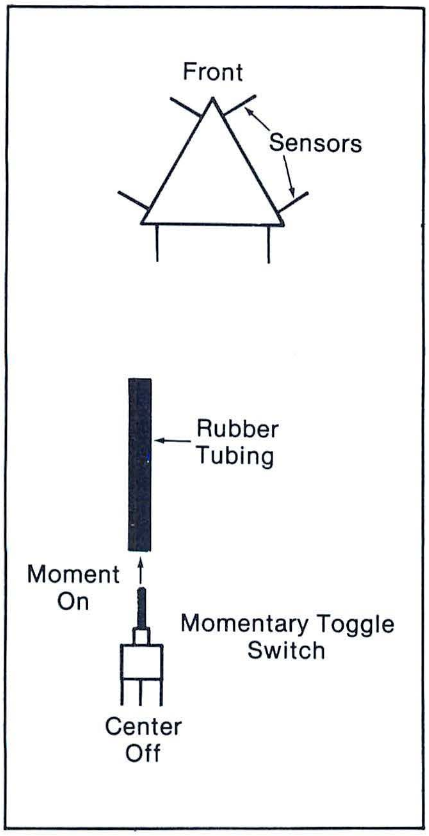
Enthused and Excited!
Chandler Paris
Brooklyn, N.Y.

We intend to continue reporting on these important developments and we appreciate your interest. It was also enjoyable working on it. —Editor

Dear Editor:

In the April issue, Tod Loofbourrow asked for any suggestions for some sort of protective guidance system. Since no address was given, I'm writing to you in the hope that you'll be able to forward my suggestion.

For a guidance system, to protect the robot from crashing into the walls, possibly a type of cilia will help. It's not too expensive. All that is required is a length of rubber tubing attached to a double (dpdt) momentary switch (please refer to diagram).



When the circuit is completed due to activation of the momentary switch, the appropriate action is taken.

Chandler Paris
Brooklyn, N.Y.

Dear Editor:

I am interested in hobby computers and would like to correspond with other hobbyists in America. Hobbyists interested in corresponding can contact me at: 34, J1n Datuk Jaffar, Taman Larkin, Jeher Baru, Johore, West Malaysia.

Tan Ghee Siak
Johore, Malaysia

Dear Editor:

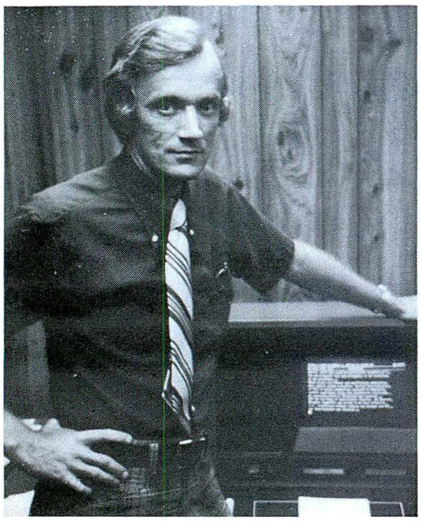
Please advise us how we can get a list of programs on your software depository. We have an HP 9830A computer and use basic language for it.

Anastasio Villa Bores
Mexico 19, D.F.
Mexico

Microcomputer Software Depository
2361 Foothill Bl., Pasadena, CA 91107

SENSE LINE

Bill Sevedge



Are your club meetings interesting? Does the club format change from month to month? I'm going to offer several concepts hopefully which will encourage the members to attend and participate at the meetings and display their systems.

Let's start with variety.

Family Day — Bring the wife and kids; show them you aren't the only one to get involved in a hobby. Members are encouraged to bring their systems and to run games, pictures, bio-rhythm charts, and programs of interest to the women and children.

Hardware/Software Swap Meet — I'm sure that you have had this type of project in the past either formally or informally and nearly everybody in your club has the same programs by now, but have you thought to invite other clubs from the area, or from nearby cities?

Trade your software and sell unused hardware or parts. Get to know your neighbors. Make arrangements beforehand to visit each other's club.

Door Prizes — Put aside some of those club dues to purchase a door prize or two to be given out at your meetings. If encouragement is needed to motivate members to bring in their systems, limit a special prize to those who bring in their hobby. It may be possible to persuade a local computer store to donate a gift as a goodwill gesture.

Refreshments — Do you presently offer refreshments after your meeting? Why not encourage the members to bring a little something to round out the meeting as well as your waistlines?

Seminars on Digital Troubleshooting, Soldering School — Locate (if possible) an electronics firm in your area and have them save you their scrap printed circuit boards. These can be cut up to individual sizes and used as practice for this type of class. You may even be fortunate to have a components manufacturer in your area. Collect defective components to solder onto the scrap PCBs.

Flowcharting and Problem Solving — Help to derive new ideas into software. How many clubs are still handwriting their envelopes? How many more are doing their club business manually? Come on! This is a COMPUTER CLUB—USE IT! Did you know there are many college or junior college professors who may be willing to give instruction to a group? Many may do this possibly at no cost.

What about a mini-convention? This type of event could be held once or twice a year. Try for donated space first, such as the banquet room in the local church. Invite the local computer stores and nearby computer industry manufacturers to display their new products. Have your members bring in their systems and each should have a booth to show his equipment and answer questions. Seminars can be held either during the show or directly after. Get speakers from the computer industry. Make it open to the public—free if possible. If costs are involved, charge the minimum possible. Advertise the event with fliers posted in computer stores and send press releases to computer hobbyist magazines. If the show can be put on for little or no admission charge, and your club is a non-profit organization, you may be able to get free air-time on local radio or television stations during their public service announcements. Pattern your show on the professional trade shows. Variety will keep the membership growing and its regular members interested.

NOW $2750. AMERICA'S LOWEST-PRICED PERSONAL COMPUTER SYSTEM WITH COLOR VECTOR GRAPHICS.

By taking advantage of the new technologies available to the industry today, we've consistently been able to give you one of the best prices on the market. Now because of great response, we can give you the best price. You can now buy the Compucolor 8001 for the reduced price of $2750. A complete stand-alone system with expanded graphics software for plotting points, vectors and bargraphs on a 160 x 192 addressable grid—in color. Eight independent background and foreground colors.

The Compucolor 8001 has an Intel 8080 CPU, 34 I/O ports and a color display with an effective band width of 75 MHZ compared to 5 MHZ for standard TV sets. In fact the Compucolor is the only totally integrated system on the market which includes a color display. You can also have special options for the Compucolor 8001 right now, including: Mini Disk Drives for extra memory, light pens and a variety of special keyboard features.

BASIC 8001 Is Easy To Learn.
Compucolor's BASIC 8001 is a conversational programming language which uses English-type statements and familiar mathematical notations. It's simple to learn and easy to use, too. Especially when it comes to intricate manipulations or expressing problems more efficiently. The BASIC 8001 Interpreter runs in ROM memory and includes 26 statement types, 18 mathematical functions, 9 string functions and 7 command types for executing, loading, saving, erasing, continuing, clearing or listing the program currently in core.

Expandable Memory To 64K.
The Compucolor 8001 has 11K bytes of non-destructible read-only memory which handles the CPU and CRT operating systems as well as BASIC 8001. Sockets are in place for an additional 21K of EPROM/MROM memory. The Random Access Main Memory has 8K bytes for screen refresh and scratch pad, 8K bytes for user workspace and room for 16K bytes of additional user workspace. The Compucolor also comes complete with a convenient mass storage device, Floppy Tape Memory. It's an 8-track continuous loop tape system, with a Baud rate of 4800 and an extra storage capacity of up to 1024K bytes per tape.

Color Graphics At Alphanumeric Black And White Prices.
That's what we're becoming famous for, and thanks to the tremendous response to the Compucolor 8001, we've been able to reduce our price even lower—to $2750. Look over our dealer listing on the adjacent page for the dealer nearest you. Then drop by for a demonstration. And while you're checking out the Compucolor 8001, check out your dealer's financing plan. He can help you turn a good deal into a good deal more.

Compucolor Corporation, P.O. Box 569, Norcross, Georgia 30091.

Compucolor Corporation

CIRCLE INQUIRY NO. 30

Update

WORKSHOPS

The Institute for Professional Education will be offering three workshops on "Structured Design and Programming," "Effective Leadership of Data Processing Projects," and "Effective Computer Operations Management."

The "Structured Design and Programming" workshop will be held June 27-29 in Washington, D.C., July 20-22 in New York, NY; and August 17-19 in Denver, CO.

The workshop on "Effective Leadership of Data Processing Projects" will be held June 8-10 in Washington, D.C.; July 25-27 in San Francisco, CA; and August 24-26 in Boston, MA.

The workshop on "Effective Computer Operations Management" will be held June 20-22 in Washington, D.C.; July 6-8 in New York, NY; and August 8-10 in Kansas City, MO.

Prepaid tuition for each of the workshops is $395 per person. Billed tuitions are $445.

For further information on the workshops contact the Institute for Professional Education, Suite 601, 1901 N. Fort Myer Drive, Arlington, VA 22209.

GAMBLERS GREET "BRIAN"

"Brian" is a Jacquard J-100 computer recently purchased by SRS Enterprises Inc., the parent company of *Gambling Times*. Brian performs the mundane tasks assigned to all computers, accounts and subscriptions, but in addition it is programmed for extensive research into the entire range of wagering games and activities. The goal of this work is to learn as much as possible about the mathematical probabilities involved in the various betting activities, and to use that knowledge to develop systematic playing procedures. These data will minimize the element of chance in wagers by relying upon factual information not previously available.

NCC: THE GREAT COMPUTER ROUNDUP JUNE 13-16, DALLAS, TEXAS

A record setting roundup of the latest trends and developments in computing and data processing will be offered at the 1977 National Computer Conference, June 13-16 in Dallas. This year's NCC, the first ever held in the Southwest, will provide a vital learning experience for all those individuals whose business or professional activities involve, or are affected by, information processing technology and techniques. An exhibit program will feature the participation of more than 300 organizations, plus a wide range of featured events and special activities.

PERSONAL COMPUTING AT NCC

The dynamic and fast-growing field of personal computing will receive special attention during '77 NCC. Personal computing is most definitely an idea whose time has come. Nearly 150 computer clubs already have been organized and more than 300 retail computer stores presently serve more than 100,000 hobbyists. Against this background, the personal computing program, under the direction of Harold A. Mauch of PerCom Data Company, will include:

- A personal computing fair with prizes and awards for the best non-commercial displays.
- Two full days of program sessions, covering personal computing hardware, software, and systems; and new trends in computer stores.
- A personal computing exposition covering the latest innovations in personal computing products and services.
- A national club congress which will bring together representatives of clubs from throughout the U.S.

Additional conference highlights will include the first NCC national programming contest, the annual computer science film theater, special tours, and the Monday evening all-conference reception.

CALENDAR

June 1 Northwest Computer Club will hold its meeting at 7 PM at the Pacific Science Center, Room 200, located on 2nd Ave., in North Seattle, Washington.

June 1 New England Computer Society Inc. will be meeting in the cafeteria of the Mitre Corp. at 7 PM. Located on Rte. 62, in Bedford, Mass. Contact Dave Day at (603) 434-4239 for details.

June 1 SCCS-Valley Chapter meets at 7 PM at the Harvard School, 3700 Coldwater Canyon, Studio City, CA. Call John Scott at 849-4094 for more details.

June 4 Louisville Area Computer Club meets at 1 PM in the Speed Auditorium of the University of Louisville, KY. Details from Glenn Darwin (502) 456-5589.

June 4 South Central Kansas Amateur Computer Association will meet at 9 AM at 1430 E. Kellogg in Wichita, KS. Cris Borger has details. Call (316) 265-1120.

June 4 Ventura County Computer Society (SCCS) meets at 7:30 PM at the Camarillo Public Library located at 3100 Ponderosa Drive, Camarillo, CA. For Club details write VCCS, P.O. Box 525, Port Hueneme, CA 93041 or call (805) 985-2631.

June 5 North Orange County Computer Club meets at California State University, Fullerton. Contact Lorin Mohler at (714) 998-5831 for further information.

June 8 Homebrew Computer Club meets at 7 PM at the Stanford Linear Accelerator Center Auditorium, in Menlo Park, CA. Call Bob Reiling at (415) 967-6754.

June 10 Crescent City Computer Club will meet at the University of New Orleans, Lakefront Campus at 8 PM. Call Bob Latham (504) 722-6321 for details.

June 10 Northern New Jersey Amateur Computer Club meets at the Fairleigh Dickinson University, Rutherford Campus, Room B8, in Becton Hall. Meeting will start at 6:30 PM. Write to NNJACC, 593 New York Ave., Lyndhurst, NJ 07071.

June 10 Midwest Affiliation of Computer Clubs, Inc. will hold its Annual Club Congress at the 2nd Annual Midwest Regional Computer Conference being held at the Bond Court Hotel, 777 St. Clair Ave., Cleveland, OH. For more details write MACC, P.O. Box 83, Brecksville, OH 44141.

June 11 Oklahoma Computer Club will hold its meeting at the Belle Aisle Library at 10 AM. Call Al Campbell at (405) 842-4933 for club agenda.

June 12 South Eastern Michigan Computer Organization meets at 6 PM at the studios of WJBK-TV-2 Call Dick Wier at 565-3228 for details.

June 15 Northwest Computer Club will hold its meeting at 7 PM at the Pacific Science Center, Room 200, located on 2nd Ave., in North Seattle, WA.

June 17 Amateur Computer Group of New Jersey will be holding its regular meeting and flea market. 6:30 PM at UCTI, 1776 Raritan Rd., Scotch Plains, NJ.

June 18 South Central Kansas Amateur Computer Association meets at 9 AM at 1430 E. Kellogg in Wichita, KS. Call Cris Borger for details at (316) 265-1120.

June 18 North Texas Computer Hobbyist Group will meet at 1 PM in University Hall Room 108 at the University of Texas, Arlington, TX. Call (817) 244-1013 for details.

June 18 Winnipeg Microcomputer Club meets at 2 PM in Room A109 at Red River Community College, in Winnipeg, Ontario, Canada.

June 22 Homebrew Computer Club will meet at 7 PM at the Stanford Linear Accelerator Center Auditorium. Call Bob Reiling at (415) 967-6754.

June 22 Diablo Professional Users' Group meets at 8 PM in the library conference room of the Diablo Valley College. For more information call Bob Hendrickson at (415) 687-8373.

June 23 Space Coast Microcomputer Club will be holding its meeting at 7:30 PM at the Merritt Island Library, Merritt Island, FL. Contact Ray Lockwood at (305) 452-2159 for details.

June 23 New York Amateur Computer Club meets at 7 PM. Call Bob Schwartz for meeting place at (212) 663-5549.

June 24 Washington Amateur Computer Society will have its meeting at 8 PM in the Catholic University of America, St. Johns Hall. Located at Michigan Ave. and Harewood Ave. N.E., Washington, DC. Call Bill Stewart at (202) 722-0210.

June 26 Chicago Area Computer Hobbyist Exchange (CACHE) meets at 12 PM in the cafeteria of the NIGAS Bldg., on Schermer Rd., Glenview, IL. Call or write to CACHE, P.O. Box 36, Vernon Hills, IL 60061 or (312) 620-1671.

June 27 Minnesota Computer Society will hold its meeting in the Brooklyn Center Community Library at 7:30 PM, Brooklyn Center, MN.

July 2 Milwaukee Area Computer Club will meet at 1 PM at the Waukesha County Technical Institute, New Berlin, WI. Call (414) 246-6634 for further information.

July 2 Louisville Area Computer Club meets at 1 PM in the Speed Auditorium at the University of Louisville, KY. Details from Glenn Darwin at (502) 456-5589.

July 2 South Central Kansas Amateur Computer Association meets at 9 AM at 1430 E. Kellog in Wichita, KS. Contact Cris Borger at (316) 265-1120 for club agenda.

July 2 Ventura County Computer Society (SCCS) meets at 7:30 PM at the Camarillo Public Library located at 3100 Ponderosa Drive, Camarillo, CA. For more details write: VCCS, P.O. Box 525, Port Hueneme, CA 93041 or call (805) 985-2631.

July 6 Northwest Computer Club will be holding its meeting at 7 PM at the Pacific Science Center, Room 200, in No. Seattle, WA.

July 6 Homebrew Computer Club meeting will begin at 7 PM in Menlo Park, CA at the Stansord Linear Accelerator Center Auditorium. Call (415) 967-6754 for details.

July 6 SCCS Valley Chapter will be meeting at the Harvard School, 3700 Coldwater Canyon, Studio City, CA. The meeting will commence at 7 PM.

July 6 New England Computer Society, Inc. will meet at the cafeteria of the Mitre Corp. (located on Rte. 62 in Bedford, MA.) at 7 PM.

July 8 Crescent City Computer Club will hold its meeting at the University of New Orleans, Lakefront Campus at 8 PM. Call Bob Latham at (504) 722-6321 for more information.

July 8 Northern New Jersey Amateur Computer Club (NNJACC) will hold its meeting at Farleigh Dickinson University, on Rutherford Campus, Becton Hall Room B8. This meeting will begin at 6:30 PM. For more information write: NNJACC, 593 New York Ave., Lyndhurst, NJ 07071.

July 9 Oklahoma Computer Club will hold its meeting at the Belle Aisle Library at 10 AM. Call Al Campbell at (405) 842-4933 for details.

July 10 North Orange County Computer Club will have its meeting at California State University, Fullerton. For more details on time and room call Lorin Mohler at (714) 998-5831.

July 10 South Eastern Michigan Computer Organization will hold its meeting at the studios of WJBK-TV-2 at 6 PM. Contact Dick Wier at 565-3228 for more information.

July 16 North Texas Computer Hobbyist Group has its meeting at 1PM in the University Hall, Room 108, located at the University of Texas at Arlington, TX. Call (817) 244-1013 for more information.

July 16 Winnipeg Microcomputer Club will be meeting at Red River Community College, Room A109 at 2 PM.

July 16 South Central Kansas Amateur Association meets at 9 AM at 1430 E. Kellog in Wichita, KS. Call Cris Borger at (316) 265-1120.

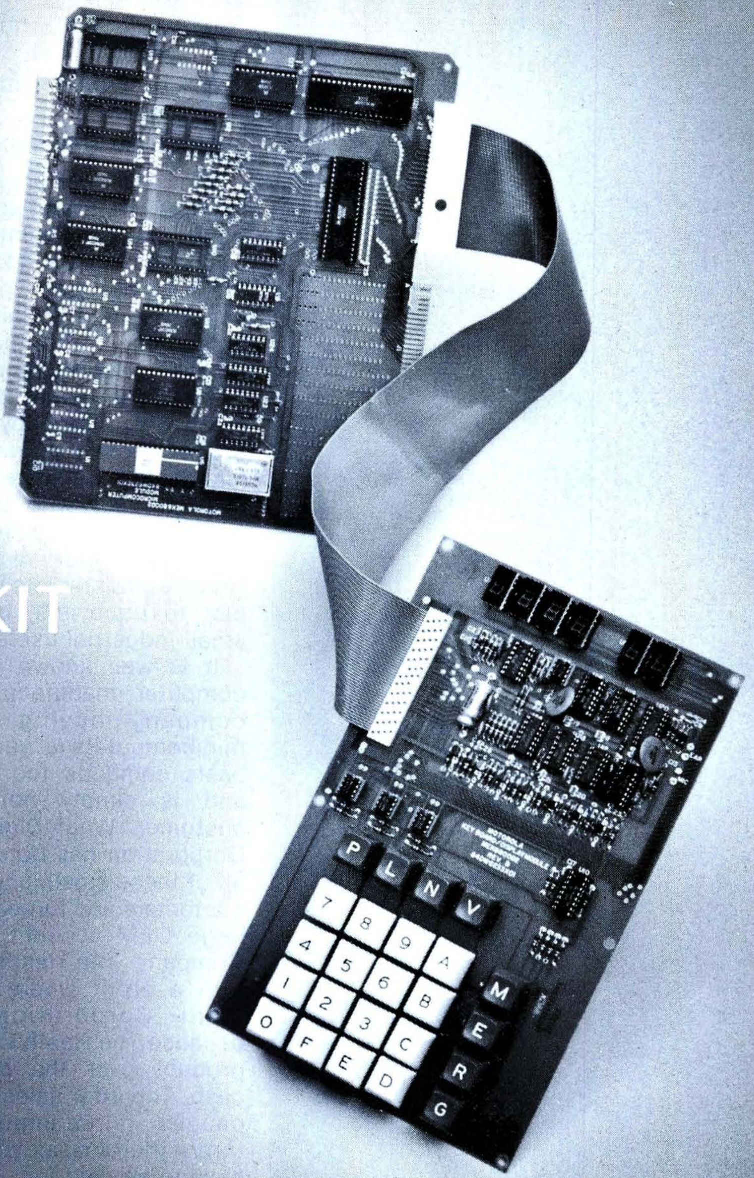
July 20 Northwest Computer Club will be meeting at 7 PM at the Pacific Science Center, Room 200, located in No. Seattle, WA.

July 20 Homebrew Computer Club will be meeting at the Stanford Linear Accelerator Auditorium at 7 PM in Menlo Park, CA Call Bob Reiling at (415) 967-6754 for details.

NOW FULLY ASSEMBLED OR IN KIT FORM MOTOROLA MEK6800D2®

MEK6800D2: A complete computer for $269.00.* 20 I/O lines, 1K monitor, 256 bytes of user RAM, serial I/O, keyboard display, cassette interface. MEK6800D2 KIT designed for individuals requiring a minimum of instruction. FULLY ASSEMBLED MEK6800D2 UNIT offered with our extras: sockets for all I.C.'s and attractive case for keyboard display.

AUDIO ENGINEERING
121 Wisconsin N.E.
Albuquerque, New Mexico 87108
505–255-6451



HEP EDUCATOR II® KIT

HEP EDUCATOR II: A complete computer for under $170.00.* 512 byte monitor, 128 bytes of RAM, parallel I/O, cassette interface, fully expandable. Designed for the do-it-yourselfer; comes with detailed instructions.

* less power supply
® a registered trademark of Motorola

- ☐ MEK6800D2 fully assembled $269.00 .... ______
- ☐ MEK6800D2 KIT $235.00 .... ______
- ☐ KEYBOARD/DISPLAY CASE $12.50 .... ______
- ☐ HEP EDUCATOR II KIT $169.95 .... ______
- ☐ HEP POWER SUPPLY KIT $29.95 .... ______

Subtotal ______

N.M. residents add 4% sales tax ______
Shipping and handling $3.00 ______

Total ______

AUDIO ENGINEERING 505–255-6451
121 Wisconsin N.E. Albuquerque, New Mexico 87108

- ☐ Check Enclosed
- ☐ Money Order Enclosed
- ☐ Bank Americard (Visa) #__________ Expiration Date ______
- ☐ Master Charge #__________ Expiration Date ______

Signature ______________________

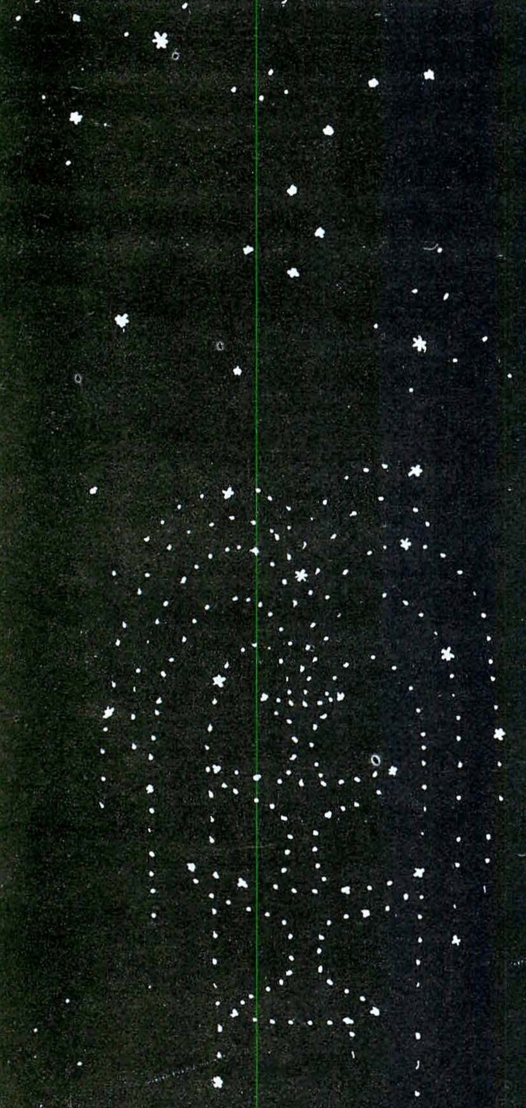
____
Name

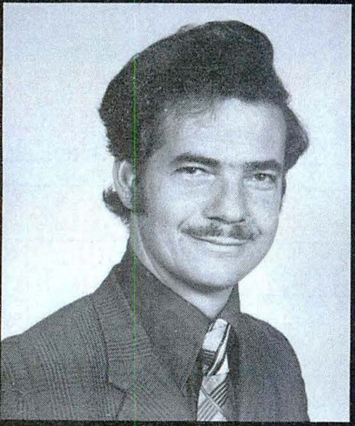
____
Street Address

____
City State Zip

. . . FROM THE FOUNTAINHEAD

By Adam Osborne





The Heath Company has been running tantalizing advertisements, conditioning us all for its entry into the home computing market. The formal announcement is scheduled for August, at which time we shall hear about these three products:

1) An LSI-11 microcomputer system
2) An 8080A microcomputer system
3) A 6800 Training Kit

The LSI-11 system is undoubtedly the most important product that The Heath Company is introducing. This will be the first LSI-11 kit available to the hobbyist; but what is far more important is the fact that Digital Equipment Corporation has agreed to let The Heath Company take most of the small industrial OEM market along with the hobby market. (OEM stands for Original Equipment Manufacturer and refers to the industrial user who buys minicomputers or microprocessors to put into some other re-sold product). Heath computer kits will be sold not just to hobbyists, but as well to small industrial users.

It is well known amongst minicomputer manufacturers that the company buying five or ten minicomputers a year on an OEM basis demands too much support and is simply not a profitable customer. What Digital Equipment Corporation has done is bundle up all of these small, unprofitable OEM customers and turned them into one large OEM account — The Heath Company. The Heath Company can turn a profit where Digital Equipment Corporation could not because The Heath Company sells a product over the counter — for cash. The after sales support which causes minicomputer manufacturers their losses will from now on have to be paid for.

The LSI-11 system sold by The Heath Company will consist of a CRT and keyboard, with the CPU mounted in the CRT, along with 32K 16-bit words of memory. The total kit price for this configuration will be somewhere between $2,000 and $2,500. Peripherals will include floppy discs and the decwriter. Additional peripherals will be made available in the future.

But the real hook in the LSI-11 system is the fact that the entire Digital Equipment Corporation PDP-11 software library will be available at nominal cost to the Heath Kit LSI-11 buyer. This includes RSX11D, RSX11M, the many higher level programming languages, everything. Not until you have been in the minicomputer systems business for a while, can you possibly understand what this software library is really worth.

The Heath Kit 8080A system will be a typical microcomputer, with peripherals and capabilities equivalent to those generally available. The 6800, however, is included in a training kit; this will be one of the typical home study courses in which The Heath Company excels — and not a basis for a microcomputer system.

None of the Heath Company products will be compatible with anything else on the market today. Specifically, the S100 bus has been ignored. Thus if you buy Heath Company kits you will be limited to Heath Company products, or you must build your own additional hardware.

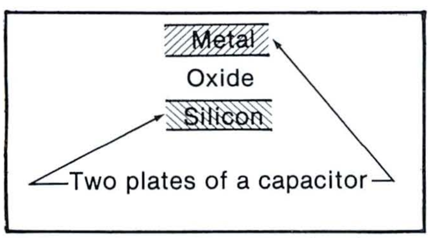
All Heath kits will come as assembled boards. There will be no bags of chips which you have to stuff into boards and solder yourself. This is the intelligent way to go and those kit builders who are not already taking this path are likely to do so in the not-too-distant future. It is important that you, the hobbyist, understand the real reason why kit companies have sold bags of chips and boards, rather than selling assembled boards. It has nothing to do with the cost of assembling the board; done commercially that costs approximately $3.00 per board. If you sell an assembled board, you are obliged to sell a product that works and includes only tested parts. If you sell a bag of chips, then you do not test the chips, since the hobbyists might damage them in the process of assembly. So the hobbyist assembles a board, and if it does not work, there is no way of determining whether the chip was damaged during assembly, or whether it was delivered in a non-working condition. Thus the true economics of selling unassembled boards to hobbyists lies in the fact that the hobby kit manufacturer can buy untested parts from the semiconductor house — and they cost less — then he can avoid testing the parts which he resells to you. Any hobbyist is going to have a hard time convincing a kit manufacturer that a defective part came defective, rather than having been wiped out during the assembly process.

What impact is the Heath kit entry expected to have on existing computer stores? Probably not much. First of all, anyone who is into the S100 bus will have little or no interest in the Heath Company entry, since it means that everything he has so far developed must be scrap-

ped — and he must restart from the beginning. Moreoever, if he goes into a computer store he can choose from a wide variety of products. If he goes to The Heath Company, he chooses from their product line alone. That does not mean to say that the Heath computer kits will be unprofitable nor unsuccessful for The Heath Company. There are enough Heath kit addicts to guarantee The Heath Company's success; and anyway, this market is growing fast enough to give everyone a reasonable share.

At last there is information available on the new Hewlett Packard microcomputer. This microcomputer is called MC2. The most significant aspect of this microcomputer is the technology which has been used to build the CPU chips. Not only does Hewlett Packard use Silicon-On-Sapphire (SOS) technology, but they use CMOS as well.

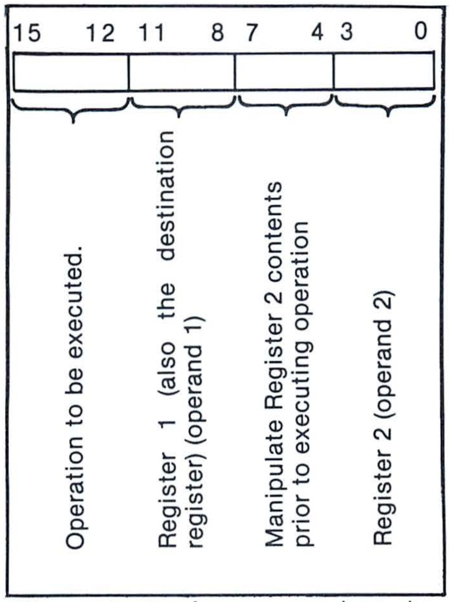
The significance of Silicon-On-Sapphire technology is that it allows faster microelectronics by eliminating parasitic capacitance. NMOS and PMOS result in metal connectors being separated from a semiconducting silicon substrate by an oxide resistor. This may be illustrated as follows:



Every time voltage levels change in the metal conductor there is a parasitic voltage change dragging through the silicon substrate; voltage level changes must take place slowly enough for these parasitic voltages to die away. Silicon-On-Sapphire replaces the silicon with artificial sapphire, which is a resistor. All silicon between the metal conductor and the inert sapphire substrate is removed, thus there is no parasitic capacitance accompanying voltage level changes in metal conductors.

The problem with Silicon-On-Sapphire is that it is no easy task to build chips using this technology; in fact, one of the earliest microprocessor disasters was the General Automation LSI-12; it became a disaster because Rockwell International could not build Silicon-On-Sapphire CPU chips in any reasonable quantity. Hewlett Packard has managed this task, albeit two years later, and done so using CMOS technology to boot.

But the Hewlett Packard MC2 will not be very interesting to hobbyists. This is a product which has been designed for process control applications; it is more like the SMS 300 than any other existing microprocessor. MC2 is a 16-bit microprocessor with very limited memory access capability, but very powerful register-to-register instructions and bit manipulation capabilities. The MC2 CPU has eight 16-bit registers. All external I/O devices in any configuration. Instructions draw their operands from any two 16-bit registers — internal CPU registers or I/O device register. Object codes may be illustrated as follows:



The contents of one operand may be manipulated at the 4-bit or byte level.

Instructions execute in less than 1 microsecond, which makes this an extremely fast microprocessor for process control applications. But memory access logic is quite limited. You can load data from memory, or store data in memory. The first 256 words of external memory are treated as a stack. But that is all you can do with memory.

MC2 is unlikely to be available commercially as a chip in the foreseeable future. This microprocessor was developed by Hewlett Packard principally for internal use and it is not clear at this time whether they will market the product even as a microcomputer card.

In the May column I asked when someone would develop a Z-80 assembler that uses 8080 mnemonics. Roger Amidon of Technical Design Labs was quick to call me to point out that his company has offered just such a product since last October. Sorry about that, Roger.

Bionics Special

EDITORIAL

by Linda Folkard-Stengel, Associate Editor

The two most exciting developments of the Electronic Era have been robotics and bionics. In the April issue we featured a special section on robotics. The material was colorful, whimsical and thought-provoking. In this issue we feature bionics. These articles lack the visual appeal of those we published on robotics. Bionics is less flamboyant, but no less exciting.

Robotics and bionics are popular buzzwords which describe two aspects of cybernetics. Robotics deals with the design and construction of independent surrogate systems to perform tasks under electronic direction from human beings. Bionics deals with surrogate systems intricately associated by means of electronic signals to the person's own body and bodily functions. Control is meant to be accomplished through the body's own signal mechanisms. A robot is directed by a person; a bionic system is "worn" by a person.

The simplest bionic device is a wooden leg or a jacket crown over a tooth. Many other bionic devices in ascending order of complexity are in use. Many are commonplace. Dimmed hearing is amplified by hearing aids; failing hearts are kept in tune with pacemakers and amputated limbs are restored by prosthetic devices.

It is in the design of artificial limbs that bionics is advancing most rapidly. The recent heavy casualty count of the Indo-China conflict prompted the urgency in development in this field. The Veterans Administration has awarded a number of contracts to universities and private research organizations to develop artifices that restore functional integrity to handicapped individuals.

The two television series "Six Million Dollar Man" and "Bionic Woman" have played a constructive role in influencing public opinion on the acceptance of this science. However, the glamour of the science-fiction staging has also distorted the image of the work. The marvelous feats performed by the protagonists of the series give an impression that bodies woven into bionic systems are superior to nature. At this time in history this is patently untrue and may never be true. At best these mechanisms restore only a portion of the original function of the lost limb.

Research in bionics is slow, tedious and painstaking — in part because the human model from which the designer works is still imperfectly understood. It is relatively easier for a scientist to capture and interpret a signal from a pin-point object on another planet than for him to find, interpret and harness the nerve signals coming from his own brain which direct the actuation of his own left thumb. It is the understanding and utilization of these very nerve signals that comprize the bulk of the work in bionics research.

The lag is not in mechanics. Progress in building actuating mechanisms approaching biological efficiency has moved steadily apace. In our lifetime devices have been built that demonstrate extraordinary degrees of tactile sensitivity. Some display the added advantages of "naturalness" — they look like hands. One such cosmetically attractive model was designed about 18 years ago by Prof. Raiko Tomović at the Mihailo Pupin Institute in Yugoslavia. The limitations of the artifice rest in control. This one, with all previous prosthetic devices until recently, was controlled by learned muscle contractions. In this model an electric servomotor was employed to assist in the articulation.

Control by muscular contraction yields limited results compared to direct in-line control from brain to actuating body through the nerve network. Recent research stresses this aspect and some success has been achieved.

In the case of lower-limb prosthetics, an additional problem is encountered. First of all the system must exhibit stability during motion and then must be strong enough to sustain the weight of the body. Artificial legs with well-designed lever systems are in operation. They serve a useful purpose and have converted even bilateral lower-limb amputees once more into walkers. The success of these legs depends on how much stump remains and in the condition of the remaining muscles. Some work has been done to control leg actuation through nerve-endings, but as yet the development of these systems is embryonic. The Hexapod must tread a long journey before its technological descendants can compete with Lee Majors on the football field.

Bionics itself is a science that has up to now progressed only against steep uphill grades, but it appears that the saddle point has now been reached with the introduction of the microprocessor. The small size and low cost of the machines offer promise for ease of installation into spaces proportional for the wearing by a human with comfort and mobility. Although we found no case in which an "on-board" microcomputer had been installed into a prosthetic device, we can anticipate dramatic development along these lines in the coming years.

Although the *cyborg* (cybernetic organism) is still a person from the future, it is a pleasant thought to consider that persons debilitated by accident or disease will someday wear bionic systems with the comfort and nonchalance with which we today wear spectacles, hearing aids or implanted teeth.

A MICROCOMPUTER-AIDED PROSTHESIS CONTROL SYSTEM

Amos Freedy
John Lyman
Moshe Solomonow
Biotechnical Laboratory
University of California at Los Angeles

SUMMARY

Recent developments in microcomputer technology have suggested the feasibility of realizing self-contained, self-supporting externally energized computer-aided prostheses. This article describes a design of a microcomputer-aided arm prosthesis using myoelectric pattern recognition as the control concept. The control system is directed toward a three-degree-of-freedom arm involving flexion/extension, wrist rotation and hand supination. The pattern recognition system maps control signals from nine electrodes into coordinated motions for any possible combination of arm motors. A prototype system has been implemented and tested in the laboratory on a minicomputer. A design for further development and implementation on a microcomputer has been made, and the feasibility for a miniature control package has been established. This article recommends and discusses a specific microcomputer system which is suitable for controlling a prosthesis.

INTRODUCTION

Improved patient control can be achieved for an externally powered arm prosthesis by integrating computational capability into a system that can transform patient commands to aid control decision-making.

Numerous groups have attempted to develop control techniques which employ a computer of realtime computational operation, including resolved motion rate control[1,2]; synergic control[3]; adaptive decision aiding[4,5]; and pattern recognition control[6,7], to mention a few. These techniques attempt to improve the command capability of the patient, and to compensate for his information constraints. The requirement for a miniature computer which can be practically integrated into a prosthesis control system — and which requires low power — has resulted in slow progress to practical patient-oriented applications. Recently, however, microprocessor technology has been developed and a self contained computer-aided arm prosthesis is now feasible. The microprocessors used are single chips composed of a few large-scale integrated circuit chips in a suitable package. The chips can be assembled into microcomputer systems. The microprocessor packages provide digital building blocks for computation[8].

This article represents a description of a myoelectric pattern recognition control system which employs a microcomputer which is being integrated into a three degree of freedom arm prosthesis as a self-contained unit. All available patient control data are mapped into unique command signals in a manner compatible with operator capabilities by using computer augmentation to perform information transformation in real time. The mapping is adapted to the specific patient EMG signal patterns. The microcomputer is integrated in the arm as a self-contained unit which is imbedded in the prosthesis shell.

Implementation of these functions in a microprocessor system involves a number of evolutionary phases:

1. Development of the control system on a laboratory computer.
2. Adaptation of control system parameters to patient capabilities, and evaluation of performance.
3. Definition of microcomputer hardware and establishment of software specifications.
4. System realization with microcomputer hardware and packaging.

The system herein described has progressed through phase 3; specification of microcomputer hardware and software implementation has been completed and feasibility has been established. Actual system implementation is now in progress.

CONTROL SYSTEM CONCEPT

Following a myoelectric pattern recognition approach, our control system is centered around a computer interpretation of myoelectric signal patterns from 9 electrodes. Electrode "n" signal sources are mapped into "m" classes of patterns. Each pattern is used as a unique control signal to the arm, as signals from "n" control muscle sites are transformed into "m" prosthesis joint control signals. (In the conventional approach, each control site is uniquely linked to an arm joint.) The pattern recognition concept appears especially suitable for implementation by computer assist.

Myoelectric pattern control was first clinically demonstrated by Wirta's group at Moss Rehabilitation Center; Wirta, *et al.*[6] implemented pattern recognition on the myoelectric signals generated by upper torso muscles as correlated with arm motion. The control system which is presented here follows the same main concept but extends it to provide adaptive mapping to teach patient's individual myoelectric patterns and to create a personalized system. Rather than fitting the subject's myoelectric pattern to some standard, the effort was made to fit the system to the amputee's peculiarities.

THE ARM

The most common deficit in present upper limb amputee technology exists at the mid above-elbow level where loss of function includes elbow flexion-extension, wrist pronation-supination, hand grasp and, in many instances, humeral rotation. A prosthesis to fit this amputation level was designed. The components chosen

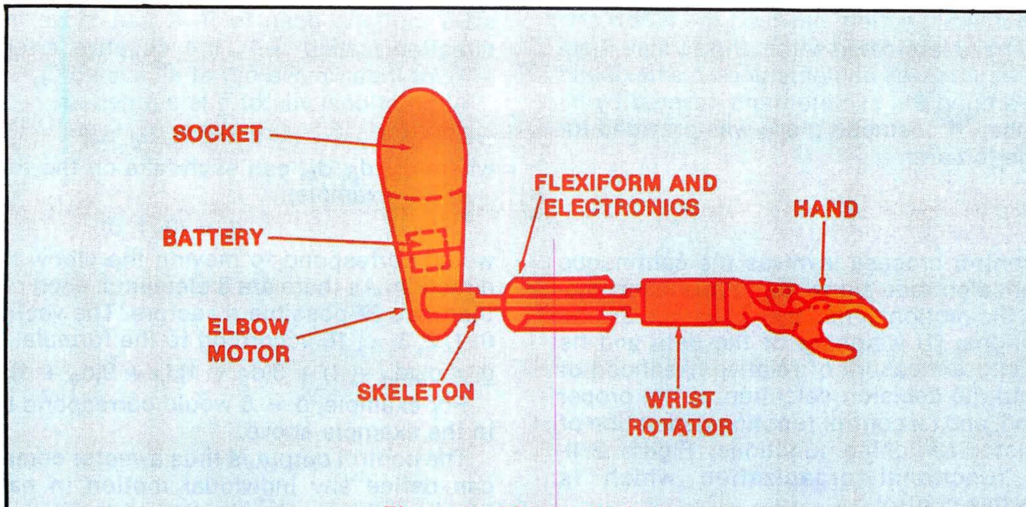


Figure 1. The Basic Arm

emphasized reliability, size, weight, and output torque. Other criteria were involved, including cosmesis, but they will not be detailed here.

In order to simplify the construction and to meet the other design criteria, the same motors were used for all degrees of freedom — the Veterans Administration (VA) electric elbow system. The basic unit was composed of an electric motor, planetary wave generator, and harmonic drive. This unit was placed in the external VA shell and provided for elbow flexion-extension. The external shell was modified to serve as a wrist pronation-supination unit. This basic unit was installed in a light weight polyvinyl chloride (PVC) shell, with attachments of the hardware to the prosthesis skeleton. To improve the motors further, the fragile and space consuming limit switches were replaced with an alternative mechanism. One aspect of the limit mechanism utilized the high reduction ratio of the gear systems, allowing the rotation to stop instantaneously upon switching the power off. A printed circuit board, layered with 2 conductive strips separated from each other, was fabricated. Two diodes allowed each strip to deliver signals of one polarity only, such that one strip powered the motor in a clockwise rotation (positive), and the second in a counterclockwise rotation (negative). Power was delivered to the motor via 2 contacts rotating on the strips. A 10K ohm ceramic potentiometer which provided angular position was also within the switching apparatus.

The terminal device chosen was the VA hand mechanism. The motor was replaced with one that was used in both elbow and wrist, providing the advantages of simplicity of service, reduction of quantity price, and the simplification of the electrodes required to drive similar units. The components were mounted on a skeleton frame, linking the elbow and wrist-hand unit as shown in Figure 1. The skeleton allowed adjustments of length for the individual forearm. The battery was incor-

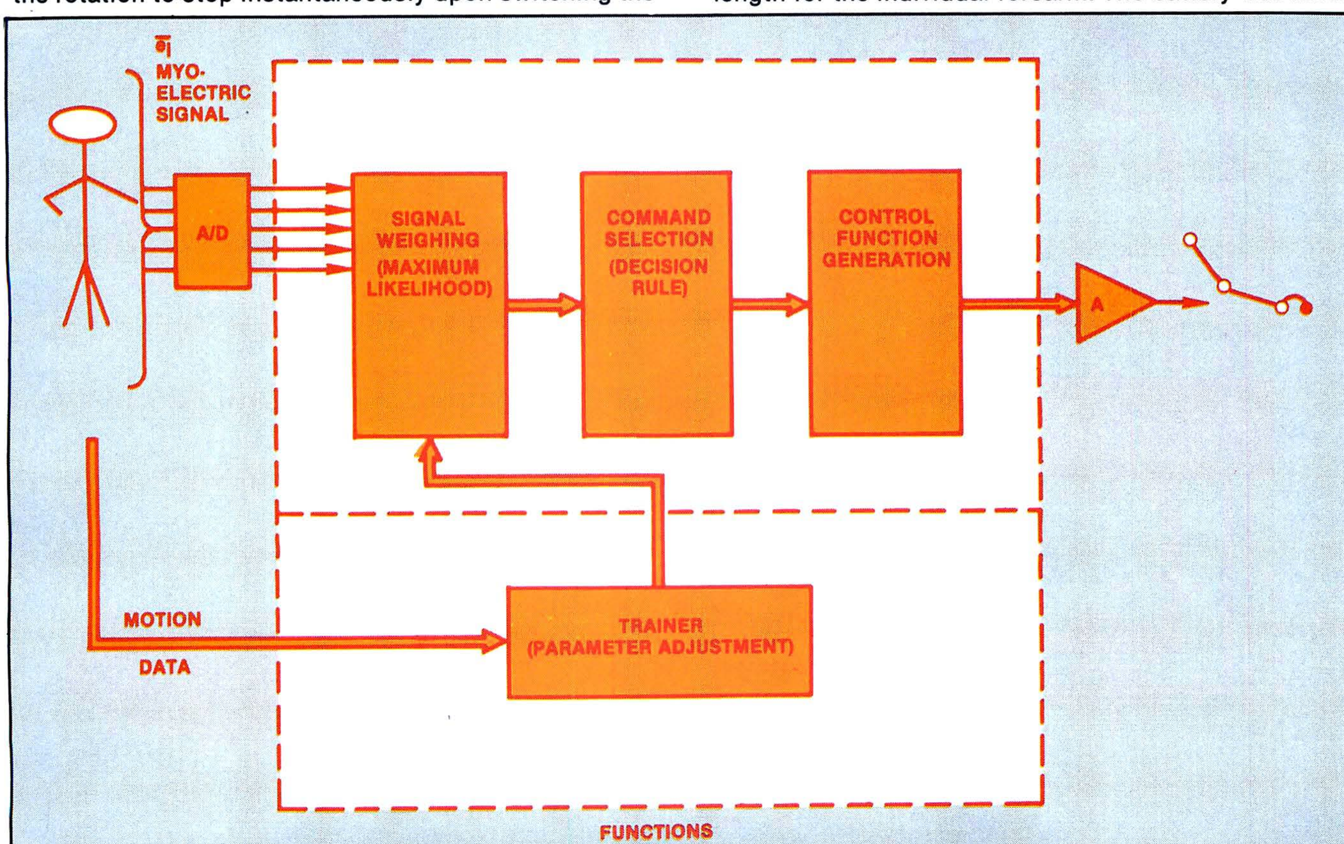


Figure 2. Control System Structure

porated in the humeral section, between the elbow and the stump, in a space fabricated within the socket. Electronic support circuitry was implemented on a flexiband that was rolled around the skeleton and covered by injected foam rubber. A cosmetic glove was provided for the hand and the forearm.

CONTROL SYSTEM STRUCTURE

The overall control process involves the continuous reading of patient electrode signal vector e and its mapping into a specific motion command. There are 3 computational functions: (1) weighing of the data and its transformation into a measure of relative likelihood of motion command, (2) decision selection of the proper motion command, and (3) control function generation of the required motor switching functions. Figure 2 illustrates the functional organization which is associated with this control.

The computational process for motion command generation is described as follows:

THE INPUT

The myoelectric signal from each electrode was quantified into 5 levels numbered 0, 1, 2, 3, 4, and was mapped into an input vector $\underline{e}$,

$$\text{Vector } \underline{e} = (\bar{e}_1, \bar{e}_2, \ldots, \bar{e}_9) \qquad (1)$$

The vector is binary. Each element e is coded into a 5-bit number which can assume a value j where j = 0, 1, 2, 3, 4.

CONTROL OUTPUT

Each degree of freedom of the prosthesis has 3 possible motions open to it. It can move in the positive direction (called +1), the negative directions (called −1), or it can move not at all (called 0).

A directional vector $\underline{d}$ is defined as

$$\underline{d} = (d_\alpha, d_\beta, d_\phi) \qquad (2)$$

where d_α, d_β, d_ϕ, can each take on the values −1, 0 or +1. For example,

$$\underline{d} = (0, 1, 0) \qquad (3)$$

would correspond to moving the elbow in the positive direction. As there are 3 elements, each chosen 3 ways, there are 27 possible $\underline{d}$ vectors. The vector is coded as 0, 1, 2, 3, ..., 16 according to the formula

$$\underline{d} = d_\alpha(d_\alpha + 1) + 3(d_\beta + 1)d_\beta + 9(d_\phi + 1)d_\phi \qquad (4)$$

For example, d = 6 would correspond to $\underline{d}$ = (0, 1, 0) in the example above.

The control output is thus a vector command $\underline{d}$, which can define any individual motion in each degree of freedom, or any combination of them at a fixed rate of motion.

DECISION RULE

Two types of pattern recognition networks have been implemented and tested. These include (1) Maximum Likelihood Decision (MLD) principle and (2) Nearest Neighbor Classifier (NNC). Each of these networks employs a different discrimination function with unique functional advantages. In the MLD network, a directional decision is selected on the basis of its likelihood as computed by using Bayes' rule and a selected loss function.

Let e = $(\bar{\underline{e}}_1, \bar{e}_2, \bar{e}_3, \ldots, \bar{e}_9)$ be the observed myoelectric pattern. Then, according to the MLD principle, the relative level of likelihood direction d_j is:

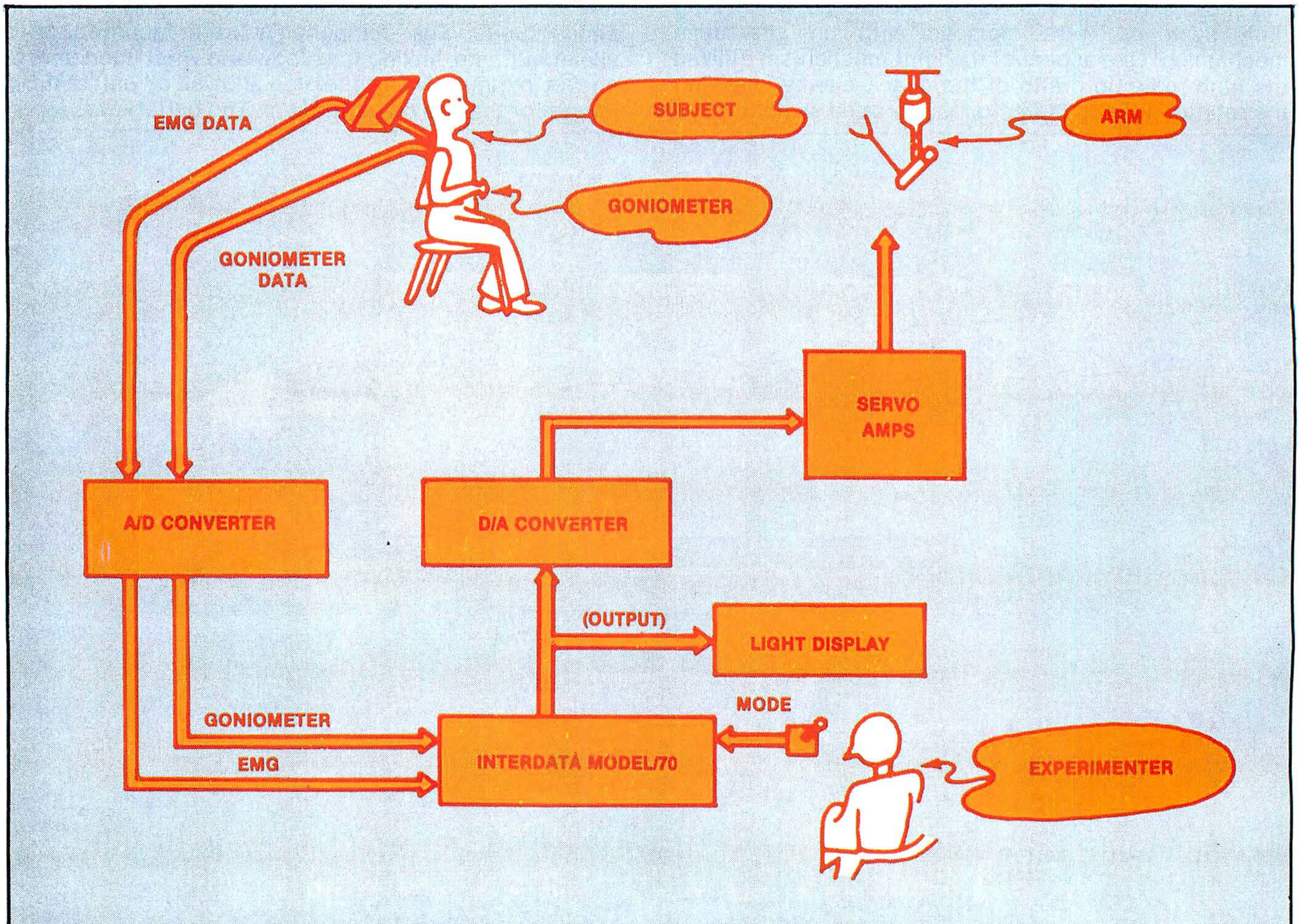


Figure 3. Experimental Setup: Non-Amputee Subject

$$\max_{\partial}\left[\prod_{i=1}^{9} p(e_i = e_i | d = \partial)\right]\left[\prod_{i=1}^{9}\prod_{\substack{k=0\\k=e_i}}^{9}\left(1 - p(e_i = k | d = \partial)\right)\right] pv(\partial)$$

where $pv(\partial)$ is the *a priori* probability for motion in the direction ∂.[5] Under the log transformation, this is equivalent to

$$\max_{\partial}\sum_{i=1}^{9}\left[\ln\left\{p(e_i = e_i | d = \partial)\right\}\sum_{\substack{k=0\\k=e_i}}^{4}\ln\left\{1 - p(e_i k | d = \partial)\right\}\right] + \ln\left\{pv(\partial)\right\}$$

The decision d^* is then accepted if the objective value of the function is greater than some arbitrarily chosen confidence level c. In this case, the scalar d^* is then mapped back into $\underline{d}^*$ vector, which can be used to control the prosthesis. If the objective value is less then c, $\underline{d}^*$ is set equal to (0, 0, 0), i.e., stand still.

The decision parameters are organized into a p-matrix, the rows corresponding to particular values for e_i for i = 1, 2, ..., 9 and columns corresponding to the directions d = 0, 1, 2, ..., 26. An entry in the p-matrix is defined as

$$P_{ik} = p(e_i = j | d = k), \qquad (6)$$

where k = 0, 1, ..., 26, i.e., the probability that electrode i takes on value j given direction k is the correct direction to move the prosthesis.

For the electrode 9 system, the decision parameters matrix contains 45 rows and 26 columns to a total of 945 conditional probability (p_{ik}) elements.

The Nearest Neighbor Classifier (NNC) uses the following decision criterion:

Let $\bar{e}$ be the observed EMG pattern ($e_1, e_2, ..., e_9$) and M be the training matrix, a 27 by 9 matrix with a row for each of the 27 possible arm directions (d = 0, ..., 26) and a column for each electrode e_1 through e_9

then

Decision Directon d = i for the minimum $diff_i$ where each $diff_i$ is

$$diff_i = \sum_{j-1}^{9} (e_j - M_{ij})^2 \qquad \begin{array}{l} i = 0 \text{ through } 26 \\ j = 1 \text{ through } 9 \end{array} \qquad (7)$$

Each row i of M represents the "locator" for direction i, that is, the row i of M is the coordinate of the 9 dimensional hyperspace point which represents direction i.

The observed EMG signal $\bar{e}$ is compared with each of 27 locators (i = 0, ..., 26) to determine to which it is closest (as measured by the Euclidean distance). $\bar{e}$ can also be considered a 9-space coordinate. Thus

$$diff_i = \sum_{j=1}^{9} (e_j - M_{ij})^2 \text{ compares the observed input "point" with}$$

the direction point i. The minimum $diff_i$ gives the direction "point" (i) to which $\bar{e}$ most closely corresponds. This direction i is taken to be the direction of motion to move the arm (each direction i = 0, ..., 26) represents an arm motion, some combination of humeral, elbow and wrist movement.

The NNC contains a training routine to initialize the 27 locator rows to proper values.

LABORATORY IMPLEMENTATION

The control system, employing the two types of pattern recognizers, was implemented on a laboratory Interdata Model 70 minicomputer, where it occupied 2.5K words of memory. An overview of the laboratory system is shown in Figure 3.

During a "learning" session (that is when the computer system adapted to the amputee's desired pattern), nine myoelectric electrodes were attached to the subject in the shoulder girdle region over muscles related to the missing limb. (Non-amputee subjects were also used in these sessions. For these subjects the electrodes were attached to muscles related to the presumed missing limb.) In addition, an arm goniometer was fitted to the "sound" (contralateral) arm. Information from both sources was fed into the computer. The subject was instructed to move his phantom limb and sound limb in parallel fashion, e.g., to extend both the phantom elbow and the sound elbow. Concurrently, the computer system "watched" the experiment and attempted to correlate the observed myoelectric pattern to the observed arm movements. This phase of the learning session was continued for only a few minutes. The learned patterns then were summarized in a conditional probability matrix, which then could be potentially transferred to the microcomputer that was ultimately to be contained in the prosthesis.

Both direct arm control and oscilloscope simulation were used in system evaluation. Correct discrimination of 95% of motion command was achieved in simulated control experiments using nine myoelectric electrodes. An operating period of 30 minutes was required.

Of the two types of discriminant function, the Nearest Neighbor Classifier was proven to be more effective, i.e., interference between motions was minimal and better discrimination was obtained.

DESIGN FOR MICROCOMPUTER IMPLEMENTATION: AVAILABLE TECHNOLOGY

Microcomputers, based on combinations of single chip microprocessors, are designed to be used in conjunction with computer-oriented equipment. The processors with all supporting modules needed to make a fully utilizable digital computer system, fit on a single printed circuit board.

In considering a microcomputer for arm prostheses, there are three primary requirements: feasible miniature packaging, adequate computational capacity and software support and low power consumption.

Microcomputers suitable for arm prostheses currently are available from several manufacturers, but selection of a specific system is complicated by the rapid rate of development of new microprocessing systems. Intel 8080 N MOS, National IMP-16C, and Teledyne TDY-52 are among those which have been evaluated for application to arm prosthesis control.

The TDY 52B of the Teledyne series, which uses a very dense hybrid fabrication process, was found to best meet the requirements. The microcomputer design exists in one or more hermetically sealed modules (packages), each having the nominal dimensions of 5 cm square by 2.5 mm in height, and a weight of 28 grams. Creation of very complex machines can be achieved by stacking and interconnecting individual modules into a system. The central processing unit (CPU) makes up one module. There are a number of additional modules, such as Read Only Memory (ROM) and Random Access Memory (RAM), and special "multiply-and-divide" hardware. Each module internally contains a ceramic substrate which provides a mounting base for components which are interconnected by means of a multilayer film process.

The TDY-52 architecture is microprogram-based, organized around a 16-bit processor. It has a primary set of 60 general-purpose instructions. Its execution speed is 7μ seconds for an "add" operation. A hardware "multiply-divide" option exists. Direct memory access is optional.

The microcomputer has a 16-bit parallel data bus. Semiconductor memory is available in an optional mix of ROM, Programmed Read Only Memory (PROM), and RAM. Each is packaged in a separate module. The processor power requirement is about 5.4 watts.

A comprehensive software support package is available for use with the TDY-52 computers. This software includes an assembler, software editor and debugger, diagnostics, utility, and other subroutines.

Power consumption still remains a problem with this microcomputer in the format described, since N-Channel Metal Oxide Semiconductors (N-MOS) components are used in the CPU. With the use of a Complimentary Metal Oxide Semiconductor (CMOS) component CPU, power requirements would be reduced to approximately 0.1 watts. Overall, the TDY-52B offers a unique, reliable small package that is computationally powerful enough to support a sophisticated control system for arm prostheses. The CMOS format for the TDY-52 is anticipated for use in the practical system.

SYSTEM IMPLEMENTATION

Transformation of the program from a minicomputer structure to a microcomputer operation depends on several simplifications to achieve adequate performance speed at low power and minimum hardware. For example, since microcomputer operations are about 5 times slower than those of the minicomputer, it is necessary to simplify the computational process and reduce the number of numeral operations. Additionally, storage accuracy should be reduced from 16 to 8 bits

whenever possible to reduce the ROM and RAM, and thus to reduce size and power consumption.

Figure 4 illustrates the basic organization of the microcomputer control system. The system can be divided into three functional units: myoelectric signal pre-process and power control, computer hardware, and arm mechanical and electronic support.

The system is centered around the processor chips and the memory. Two types of memory modules are required, ROM and RAM.

Nine preamplified and rectified electrode signals are scanned by a multiplexer and a 3-bit analog-to-digital A/D converter. The input data are used by the TDY-52B CPU to compute the relative levels of likelihood of each decision. ROM will be used to store conditional probability parameters and the permanent part of the program. It was estimated that about 2.5K bytes of ROM would be required. RAM will be used to store the variable program parameters which are used in the computational process.

The fixed part of the program includes the conditional probability matrix elements in a format of eight bits per value. There will be a total of 945 conditional probability elements required. This will occupy about half of the TDY-522A 2049 bytes of storage. Another 600 bytes will be required for program storage. One module of ROM will be sufficient.

The variable parameters which must be stored during computation are estimated to be around 200. A single module of the TDY 52 series will be sufficient.

With the TDY-52B CPU, the total computer package will then consist of three basic modules occupying a space of 5 cm by 5 cm and 7.5 mm high. Additional space will be required for the A/D and the D/A. The A/D contains a multiplexer, interface, and a 3-bit converter. Batteries may be located in the prosthesis shell or in a body mounted battery pack, depending upon the length of the amputee's stump.

The total power consumption over a conventional myoelectrically controlled arm prosthesis is a potential problem. One solution is the employment of a power control logic which would consist of low power consumption CMOS circuits that turn on the power to the computer hardware whenever myoelectric activity is initiated. The circuit is a simple threshold switching circuit which turns the computer on according to the decision rule.

ON if any $e_i > \Theta_1$ $\quad i = 1, \ldots, 9$

and

$$\sum_{i=1}^{9} e_i > \Theta_2$$

Once the computer is on, its power is shut off.

OFF if all $e_i < \alpha_1$ for time T

$$\sum_{i=1}^{9} e_i < \alpha_1$$

where Θ_1, Θ_2, α_1 and α_2 and T are variable parameters.

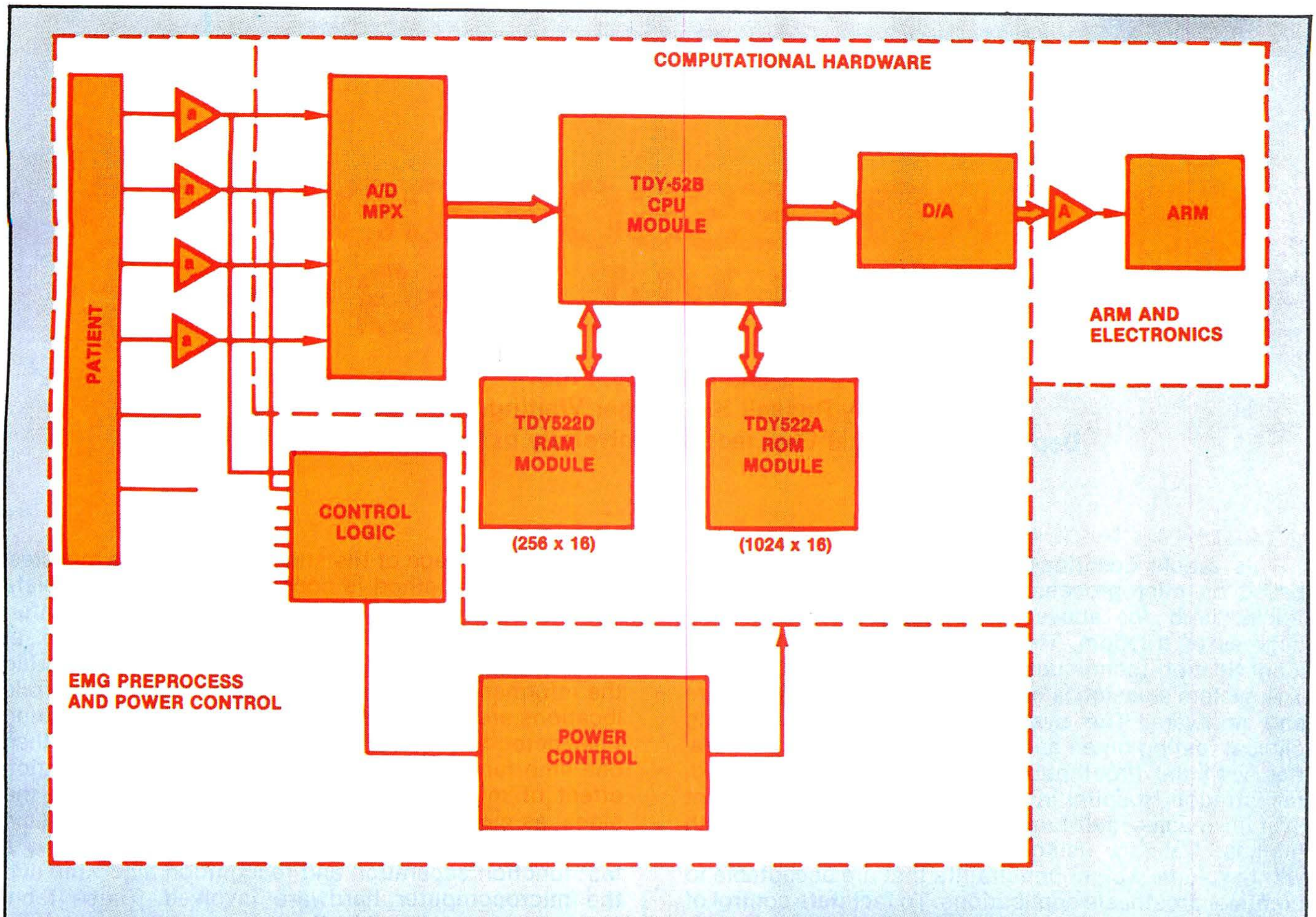


Figure 4. Microcomputer System Overview

The result is that after power has been turned on, the computer is in a standby mode for a period of T.

Using a fast-charge nickel cadmium battery pack of the type presently available for prosthesis applications, the system should be able to operate for a minimum of one day's normal activity on one charge.

DISCUSSION

It has been shown that microcomputer technology can facilitate the implementation of advanced arm prosthesis control schemes by providing external computational functions. The myoelectric pattern control system which is presented here suggests a practical example of a system which can be implemented readily on a computer, but difficult to realize by conventional means. In terms of weight and size, the proposed electronic package is within practical requirements. Power consumption remains a problem, but CMOS and other advanced microprocessor technologies should help to resolve this.

Although the design presented here covered a single type of control, it should be emphasized that, with small memory increments, other control refinements such as resolved motion control[1] and adaptive aiding[9] are feasible.

ACKNOWLEDGMENTS

Support for this research was provided by the U.S. Veterans Administration Contract V101-(134)P121.

We are most grateful to the following members of our laboratory staff for their contributions to this paper: Mr. M. Solomonow contributed substantially to the development of the arm hardware design and realization; Mr. G. Nunes implemented the computer program and contributed many useful suggestions for its development; Dr. R. Prior provided a great deal of valuable counsel and evaluative comment with respect to the specification of microprocessor technology.

REFERENCES

1. Zadaca, H., J. Lyman, and A. Freedy, "Studies and Development of Heuristic End Point Control for Artificial Upper Limbs," *University of California, Los Angeles, School of Engineering and Applied Science* Report UCLA-ENG-74-79; *Biotechnology Laboratory Technical Report* No. 54, 1974.
2. Whitney, D., "Coordinated Control of Prosthesis Arms," *Proceedings of the 23rd Annual Conference on Engineering in Medicine and Biology,* Washington, D.C., November 1970.
3. Marić, M. R. and M. M. Garrilović, "An Evaluation of Synergistic Control for the Rehabilitation Manipulator," *Proceedings of the 4th International Symposium on External Control of Human Extremities,* Dubrovnik, Yugoslavia, pp. 277-287, 1969.
4. Freedy, A., F. Hull and J. Lyman, "Adaptive Aiding in Artificial Arms Control," Bulletin of Prosthetics Research, BPR 10-16:3-15, Fall, 1971.
5. Freedy, A., F. Hull and J. Lyman, "A Learning System for Trajectory Control in Artificial Arms," *Proceedings of the 4th International Symposium on External Control of Human Extremities,* Dubrovnik, Yugoslavia, 1972.
6. Wirta, R. W. and D. R. Taylor, "Development of a Multiple-Axis Myoelectrically Controlled Prosthetic Hand," *Digest of the 3rd International Conference on External Control of Human Extremities,* pp. 245-253, Dubrovnik, Yugoslavia, 1969.
7. Lawrence, P. D., "Computer Design and Simulation of a Myoelectric Pattern Classifier for Controlling a Multifunctional Prosthetic Hand," *Digest of the 3rd International Conference on Medical Physics and Medical Engineering,* Goteborg, Sweden, p. 36.6, 1972.
8. Lyman, J., A. Freedy, and R. E. Prior, "Biotechnology Laboratory Report: Part II, Feasibility of Microcomputer Aided Prostheses," *UCLA School of Engineering and Applied Science* Report UCLA-ENG-7378, *Biotechnology Laboratory Progress Report* No. 53, October, 1973.
9. Freedy, A., F. Hull, L. L. Lucaccini, and J. Lyman, "A Computer Based Learning System for Remote Manipulator Control," *IEEE Transactions on Systems, Man and Cybernetics,* SMC-1, No. 4:356-363, October, 1971.

Bionics

MICROPROCESSOR CONTROLS PROSTHESIS VIA EMG SIGNAL

Daniel Graupe, Ph.D.
Presently Russell S. Springer Visiting Professor
Dept. of Mechanical Engineering, University of California, Berkeley

INTRODUCTION

This article describes a prosthesis control system based on microprocessor hardware to control an artificial limb for above elbow amputees in several degrees of freedom. The design employs time series identification techniques for parameter discrimination. The system's design is outlined in terms of its hardware and software. The system is presently undergoing clinical testing on an above-elbow amputee in cooperation with the Prosthetics Center of the Veterans Administration Hospital in Denver, Colorado. The present system enables multifunctional limb control at will, with minimal training, using one or two electrode sites, within volume weight constraints that are acceptable to practical prosthesis applications. To facilitate control of an increased number of functions often required in cases of bilateral above-elbow amputees or of shoulder disarticulation cases, an incorporation of the present system with a toe-controlled one for increasing number of controllable functions, is also underway.

BACKGROUND

Multifunctional control of artificial upper extremities using myoelectric (EMG) signals is of major importance in cases of above-elbow amputees. For solving this problem it is essential to distinguish between the different limb functions to be controlled from the pattern of the myoelectric signal at some or several stump locations. Hence, differences in pattern of myoelectric signals related to various limb functions (i.e., elbow bending, elbow extension, wrist pronation, wrist supination, grasp, etc.), as taken at one or several stump muscles, must be detected. Although such differences do exist, they are hardly obvious to the naked eye of even an expert. Two major approaches to solve this problem have been suggested. One, based on the works of Lawrence[1] and of Lyman *et. al.*[2], requires mapping of many (ten or more) electrode locations where the EMG function is strongly correlated with a single limb function. It thus employs the low frequency characteristics of the EMG signals and of their mapping or distribution over the various electrode locations. Furthermore, because of the number of electrode sites required, this method is limited to amputees with little nerve and muscle damage to their stump and with relatively long stumps. The other approach, based on Graupe *et. al.*[3,4], requires a far smaller number of electrode locations (one to three) for it aims at finding locations where even very weak correlations between the measured signal and (more than one) limb functions may exist.

This method is suitable for amputees with severe nerve and muscle damage in their stump. Our results presented below relate to an untrained amputee with about 90% damage of the stump's nerves and muscles. However, this method is concerned with the complete spectrum since it implies that the complete linear information content of the EMG signal is considered (i.e., at all frequencies). It is more efficient in terms of utilizing the information of the EMG signal and fewer electrode locations are considered, though at a price of requiring finer detection. The above correlation with more than one limb function is because of the spatial integration effect of muscle fiber and skin tissue affecting the signal as measured by surface electrodes[5]. This article concentrates on the latter approach and describes a fast function separation and recognition algorithm and the microcomputer hardware involved. These techniques were developed by the authors at Colorado State University.

FUNCTION SEPARATION ALGORITHM AND PARAMETER IDENTIFICATION

The present function separation algorithm is based on time series model identification as in [3], though differing in the discrimination approach and in the identification subroutine used.

Our approach is concerned with squeezing the complete linear information context of the EMG signal, so it is essential that data reduction be employed as far as possible to reduce the dimensionality of the problem without loss of information. This is achieved by means of first employing signal identification. Noting that the recorded EMG signal represents a time series that is essentially stochastic (involves a variate), our algorithm consists of identifying the parameters of the time series that is recorded in terms of an autoregressive (AR) model, given by

$$y_k = \sum_{i=1}^{n} \gamma_i y_{k-i} + \omega_k \qquad (1)$$

y_k denoting the recorded signal, $_i$ being the AR parameters, n being the order of the AR model and ω_k being white noise. The use of an AR model in this problem is justified for the following reasons:

a) It can be proved that stationary time series can be represented by an AR model[6] as in Eq. (1). Although the EMG signal is not fully stationary, it has been shown in [3] that this signal is sufficiently stationary per each limb function considered to yield AR parameters whose range of variation with time is adequately small to facilitate discrimination between limb functions.

b) It can be shown[6] that the minimum parameter linear model of a stationary time series is of the form of an autoregressive-moving average (ARMA) model given by:

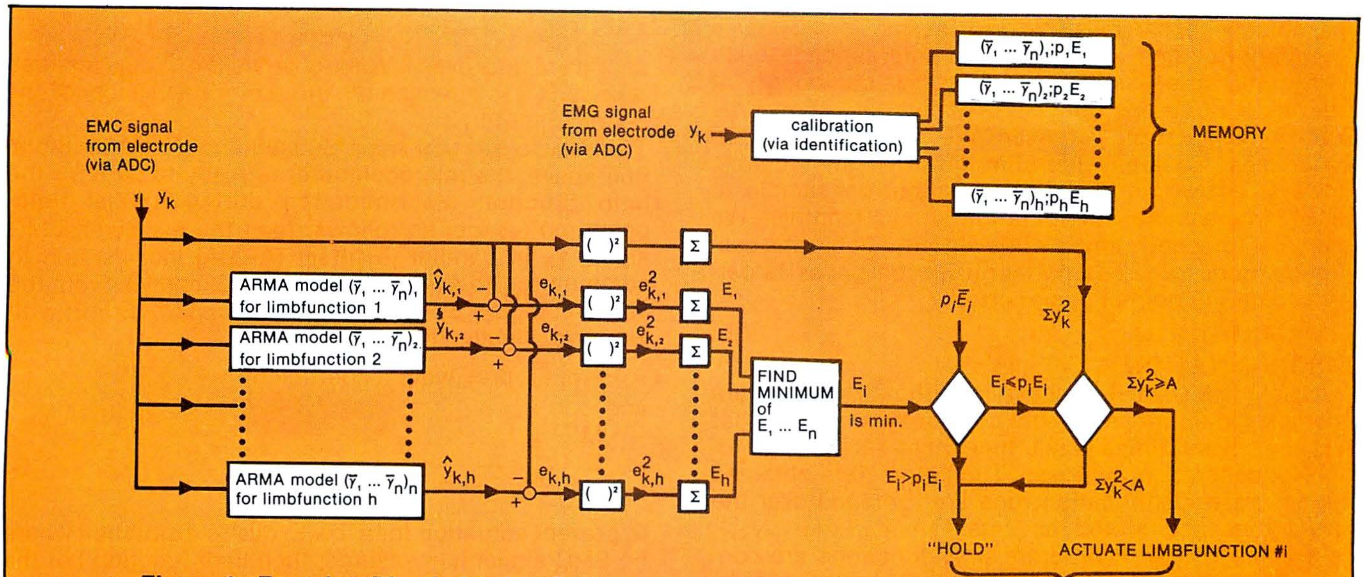


Figure 1. Function Discrimination Scheme

$$\sum_{i=0}^{m} \phi_i y_{k-i} = \sum_{j=0}^{p} \Theta_j \omega_{k-j}; \phi_0 = \Theta_0 = 1 \tag{2}$$

where y_{k-i}, ω_{k-j} are as in Eq. (1), ϕ_i, Θ_j denoting the AR and the moving-average (MA) parameters of the model respectively, m and p being the order of the AR and of the MA parts of the model. Now, via polynominal division[6], Eq. (2) can be reduced into (1), the latter not being of minimum order. However, the derivation of the minimum order ARMA parameters is rather lengthy and complex as compared with that of the AR parameters for a low AR order n. Since in our case, computational speed is of utmost importance and since it has been in [3] that for the EMG signals considered n = 3 or 4 for adequate function discrimination and for obtaining ω_k that is almost completely white (uncorrelated), we have decided to employ an AR rather than an ARMA model in our analysis and design.

c) The linear model as in Eq. (1) or (2) is fully optimal only if y_k is Gaussian, and is otherwise only linear-optimal - i.e., the best linear model for y_k. Hence, in the non-Gaussian case, a nonlinear signal model would be required for full optimality. However, without prior parameter knowledge, which is not available in our problem, no identification of an optimal model is possible in the general case, and if it were possible it would have been too lengthy and too complex from a computational point of view to be of use in a concrete prosthesis application. Furthermore, one can show that[5], the EMG signal, can be considered as an outcome of a sequence of impulses with independent Poisson-distributed intervals passed through a linear filter. Now, since the muscles involved are usually (at biceps or triceps) actuated by a large number of motor units[7], say several hundreds, the average interval above is small compared with the dominant time constant of the linear filter involved. Assuming the practical average interspike interval concerned is of the order of t = 100 milliseconds, and assuming that N = 200 motor units are involved in the muscle contraction, the Poisson rate is λ = N/t = 2000. Such a Poisson rate implies that the EMG signal involved closely fits a Gaussian process, as is well known to workers in the field, to further establish the validity of the linear AR model and make it close to an optimal one. From the above, it is not surprising that adequate limb function separation is facilitated with our approach as in [3] and further demonstrated below.

For the above reasons, and noting the speed, weight and volume constraints indicated above, the choice of an AR model is, at least, well founded.

The algorithm used for identifying the AR model above is a sequential least-squares algorithm. This algorithm can be proved to converge to the true parameters of the signal.

Furthermore, its near-maximum-likelihood properties[6] make it a near efficient algorithm and therefore of fastest possible convergence rate, and it requires the

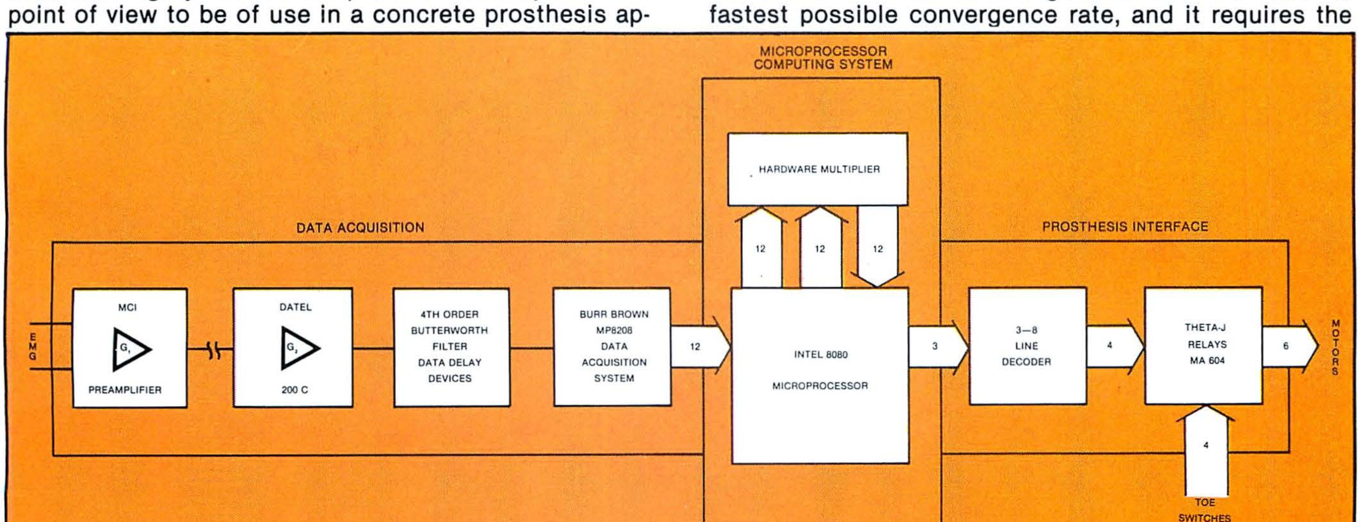


Figure 2. Block Diagram of System

least number of samples for convergence. This aspect is important noting the constraint of computational speed with a microprocessor, and noting that stationarity of the model of (1) can only be assumed over short time even for calibration purposes. We comment that the basic least squares algorithm given in [6] requires, however, a large number of computations per sample, to make intersample computation time lengthy. We therefore, presently employ this algorithm only at a calibration mode, whereas no identification per-se is performed during normal operation.

LIMB-FUNCTION DISCRIMINATION

CALIBRATION MODE The above identification procedure is employed in the prosthesis control system such that it is run several times (say L times) per each limb function for calibration purposes. The parameters obtained during these identification runs are averaged over the above runs and stored as sets $\{\gamma_{11}...\gamma_{1n}\}$; $\{\gamma_{21}...\gamma_{2n}\}$, ...$\{\gamma_{h1}...\gamma_{hn}\}$, when h different limb functions are considered, each having n parameters. Once these parameters are stored, another calibration run is made where the EMG signals $y_{k,i}$ (k = 1...N, denoting time interval) related to function i (i = 1...h) are fed to an algorithm (i.e., a filter that computes:

$$y_{ki} = \bar{\gamma}_{i1} y_{k-1} + \bar{\gamma}_{i2} y_{k-2} + \cdots \bar{\gamma}_{in} y_{k-n}; \; i = 1,..h; \tag{3}$$

(Alternatively, one may compute y_k from the ARMA model of Eq. (2) above, to yield:

$$y_k - y_{ki} = e_{ki}\,; (y_k = \text{the actual EMG signal at the k-th time interval}). \tag{4}$$

Defining:

$$E_i \triangleq \frac{1}{N} \sum_{k=n}^{N+n} e_{ki}^2\,;\; i = 1,...h \tag{5}$$

and averaging over L runs now yields $\bar{E}_1...\bar{E}_h$ for limb functions 1 to h, which are stored in the memory of the microcomputer.

NORMAL OPERATION MODE Subsequently to the calibration above, the microcomputer is ready to perform the limb function discrimination during normal limb-operation (usage) as follows: feed the measured EMG signal y_k in parallel to filters (ARMA) models 1...h to compute e_{k1} to e_{kh} as in equation (3) and (4). From the above compute E_i v i = 1,...h, and compare $JE_j = E_i$ with E_i above. Finally, if:

$$E_i \leq p_i \bar{E}_i\,;\; p_i = \text{weight coefficient} \tag{6}$$

and

$$\sum_{k=1}^{M} y_k^2 \geq A \tag{7}$$

to prevent actuation for a low E_i due to a situation where no EMG signal is measured, then limb function i of the limb functions set 1...h is actuated. Else, the prosthesis will be (or remain) in a "hold" mode.

In diagrammatic form, the present alternative design may be described as in Figure 1. For increasing speed, hardware multipliers may be used in the hardware realization of the system of Figure 1, especially in the lower half of that Figure.

Note that the present design involves only simple filtering, namely multiplication and addition, rather than identification during normal prosthesis use (during normal operation), whereas identification is solely performed during calibration. Hence, since identification is the most time-consuming part of the system, this implies a considerable time saving. However, discrimination may be somewhat sensitive with this technique in

 CIRCLE INQUIRY NO. 65

certain situations, i.e. when the parameters employed are somewhat biased because of incomplete convergence or wrong model order. Hence, if an identification-bias exists, the method of comparing parameters in a parameter vector space, as in [3], may be advantageous. (In the discrimination approach of [3], discrimination must be exact if $\overline{\gamma}=\hat{\gamma}$, whereas in the present method this is not necessarily so, since the minimal error-variance may occur for the wrong limb-function because of identification bias.) However, since in the present design, identification is performed only during calibration and not during normal operations, sufficient computation time should be usually available to reach convergence such that biases can be eliminated.

Furthermore, if access to calibration computers is adequate, the whole calibration top half of Figure 1 can be done by a calibration computer in a clinic and the related hardware will not be worn by the patient. This further reduces weight and cost. This, however, requires facilities for re-storing the parameters of that top half of Figure 1, namely $\{\overline{\gamma}_1...\overline{\gamma}_n\}_i$ and $\overline{E}_i$ for $i=1...h$ in the memory of the patient-born microprocessor system as computed by the calibration computer in the clinic.

CONTROL ASPECTS The present design (using 1 electrode pair) is in fact in terms of only 5 functions (j = 1,2,3,4,5 above), whereas grasp movement is produced by toe-actuation. Furthermore, the movement is used to interrupt movement if discrimination turns out to be wrong or to facilitate speed control. The above design also facilitates speed and torque control. A design for all 7 functions above is also ready. It involves two parallel microprocessor systems whose hardware is not yet complete, or a single very fast microprocessor where computation of the tasks of the two parallel systems above is done in series. We note that the present 5-function system employs only a single set of electrodes in contrast to two sets of the 7-function system which requires two parallel systems.

The present system involves one set of electrodes for discriminating and controlling 5-limb functions. The system feeds to a motor control and actuation unit identical to that of the toe-controlled system of [4] which is presently used by a bilateral above elbow amputee in Los Angeles.

A schematic block diagram of the system is given in Figure 2.

DATA ACQUISITION The EMG signal is obtained via an EMG preamplifier unit manufactured by Motion Control Inc. (MCI). Disc type electrodes are mounted directly on the preamplifier module which is therefore, located directly above the muscle being monitored. Because preamplification is directly above the monitored muscle, the above unit facilitates a higher signal-to-noise ratio after transmission, than is usually achieved by other surface electrodes. The preamplifier weighs only 8 grams and does not require the use of conductive jelly often used and usually very inconvenient and unreliable.

The preamplified EMG signal is fed to a Datel 200C instrumentation amplifier for further amplification. Undesirable frequencies are filtered out by a 4th order Butterworth bandpass filter (with a passband between 1.5 and 1,500 Hz) produced by Data Delay Services. A 12-bit data acquisition system, the MP8208 produced by the Burr Brown Research Corporation, samples the EMG signal at a rate of 5000 samples per second, and delivers the digital data to the microprocessor computing system. See Figure 2 for details.

MICROPROCESSOR COMPUTING SYSTEM

The microprocessor system is based on an 8080 Intel Corporation microprocessor which is an 8-bit parallel central processing unit. It is fabricated on a single LSI chip using the latest advances in N-channel silicon gates and is furnished in a 40-pin dual in-line ceramic package, having a 2 microsecond instruction time (for instructions that do not refer to memory.) The above 8080 microprocessor is then interfaced with its input-output ports and with a 4K-bytes semiconductor memory. To increase speed, since the multiply and divide instructions are the most time consuming ones in our program, the microprocessor is also interfaced with a hardware multiplier unit based on Fairchild 9344 4 x 2-bit multipler modules where multiplication time is 350 n-seconds vs. 1 m-second in the microprocessor itself. Since no division is made during normal operation, hardware division is not presently performed. With this latter arrangement, the complete recognition is performed within 0.2 seconds for the 5-function system.

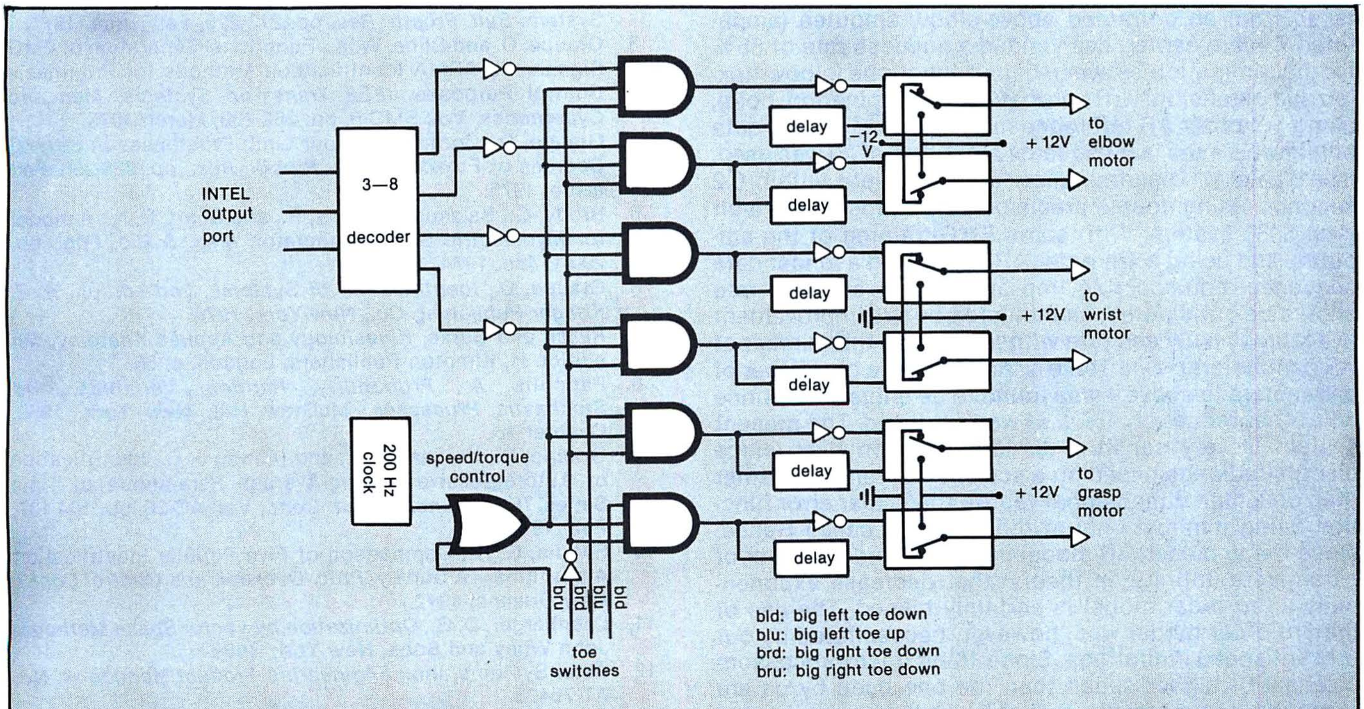


Figure 3. Prosthesis Interface

Exp. #	Identifier	Data Length	# of Parameters	#of Limb Functions	Funct. Discrim. Method	Accuracy %	Actuation Delay(sec.)
1	Seq. least Sq.	200	3 AR + Variance	5	Vector Space	85	1.3
2	Seq. least Sq.	200	3 AR + Var.	4	Vector Space	95	1.3
3	Grad. Search	200	3 AR	4	Vector Space	65	.25
4	Grad. Search	400	3 AR	5	Vector Space	65	.3
5	Grad. Search	400	4 AR	5	Vector Space	70	.3
6	Grad. Search	400	3 AR + Var.	4	Vector Space	85	.35
7	Seq. least Sq.	400	3 AR	3	Paral Filtering	85	.15
8	Seq. least Sq.	400	3 AR	5	Paral Filtering	80	.2

Table 1

Note that even with hardware available today, such as the Intel 3000 system (that was not available when equipment for this project was purchased), a ten-times faster system can be achieved using the same algorithms as above. Observing that 12-bit data are used, the 8-bit 8080 program is in terms of *double word length.*

PROSTHESIS INTERFACE

The interface between the microprocessor computing system and the prosthesis is basically identical to that of the toe-controlled prosthesis. The system may also incorporate toe control for interrupt, speed control, and grasp. The latter functions may alternatively be performed by processing EMG data from two electrode locations using either two microprocessors in parallel or one fast microprocessor operating in multiplex mode.

The microprocessor computing system latches the binary function code into an output port, from where it is decoded by a 3-to-8 1-ne decoder. The TTL-signals from the decoder control directly power DIP solid state DC relays (MA-604 manufactured by Theta-J Relays, Inc.) which switch the power to the prosthesis motors. See Figure 3.

PERFORMANCE

Our first run on the microprocessor system with data taken from an *untrained* above-elbow amputee (amputated 7 years earlier) has yielded a success rate of 85% for discrimination between 5-limb functions (elbow flexion and extension, wrist pronation and supination, hold), using 3rd order AR reference models based on 200 data points where the least squares algorithm of [6] was used, (see Table 1). Discrimination was complete within 0.2 seconds, using double precision algorithms on the 8-bit Intel 8080 system. With some EMG-training of the amputee, and using a 4th order AR model and a longer data sequence, considerable improvement in success rate should be anticipated, as indicated by the improvement in accuracy (success rate with increasing the number of AR parameters) - See Table 1. Any increase of number of parameters to above 4 was found to be unjustified, since no further reduction in E (ω_k^o) was achieved. The present system is very sensitive to identification bias (since discrimination is based on a scalar error function rather than on a high dimensional vector, the scalar error function being minimal only in the bias-free case.) Hence, since the unbiased AR model involved a high number of parameters (infinity, in theory) that decrease exponentially a 3rd order model is certainly biased. The use of the 3rd order model was, however, necessitated by our present speed limitations. Since 16-bit microprocessors of equal or higher speed than the one used by us are presently commercially available, further considerable increases in discrimination speed are a certainty, to allow increased word length and more accurate identification. More functions can be identified and the speed of the limb can be controlled by the EMG signals. Again "getting used to" the system will enable the amputee to generate signals with a narrower speed of parameters to further enhance accuracy.

FOOTNOTES

Co-authors on this work: J. Magnussen and A. A. M. Beex, Electrical Engineering Dept., Colorado State University

ACKNOWLEDGMENTS

This work was performed under contracts V-101-(134)-P-111, and V-101-(134)-P-338 of the Veterans Administration Department of Medicine and Surgery. The authors are greatly indebted to Dr. Eugene F. Murphy, Director Research Center for Prosthetics of the Veterans Administration in New York for his constant encouragement and advice.

REFERENCES

1. Lawrence, P., Computer Design and Simulation of a Myoelectric System for Controlling a Multifunctional Prosthetic Hand. *Proc. Symp. on Pattern Recognition and Mathematical Image Processing.* Chalmers University, Goeteborg, Sweden, Aug. 1972.
2. Lyman, T., Freedy, A., and Solomonow, M., Studies Toward a Practical Computer-Aided Arm Prosthesis System. *Bull. Prosth. Res.* pp. 213-225, Fall issue, 1974.
3. Graupe, D. and Cline, W. K., Functional Separation of EMG Signals via ARMA Identification Methods for Prosthesis Control Purposes, *IEEE Trans. on Systems, Man and Cybernetics,* Vol. SMC-5, pp. 252-259, March 1975.
4. Graupe, D., Control of Upper Limb Prostheses in Several Degrees of Freedom. *Bull. Prosth. Res.,* pp. 226-236, Fall issue, 1975.
5. Brody, G., Balasubramanian, R., and Scott, R. N., A model for Myoelectric Signal Generator, *Med. & Bio. Eng.,* pp. 29-41, Jan. 1974.
6. Graupe, D., *Identification of Systems. 2nd edition, R. E. Krieger Publishing Co., New York, 1976.*
7. *Rasch and Burke, Kinesiology and Applied Anatomy,* 5th edition H. Kimpton Publishers, London, p. 55.
8. Papoulis, A., *Probability, Random Variables, and Stochastic Processes.* McGraw Hill, New York, 1965, Chapter 16.
9. Graupe, D., Krause, D. J., and Moore, J. B., Identification of Autoregressive Moving-Average Parameters of Time Series. *IEEE Trans. on Aut. Cont.,* Vol. AC-20, pp. 104-107, Feb. 1975.
10. Saridis, G. N., Comparison of Five Popular Identification Algorithms—A Survey, *Proc. Decision and Control Conf.,* New Orleans, 1972.
11. Luenberger, D. G., *Optimization by Vector Space Methods,* John Wiley and Sons, New York, 1969.
12. Datel Systems, Inc., *Engineering Product Handbook,* No. AT 75408.
13. Intel Corp., *Intel 8080 Microcomputer Systems Manual,* 1975.

Bionics

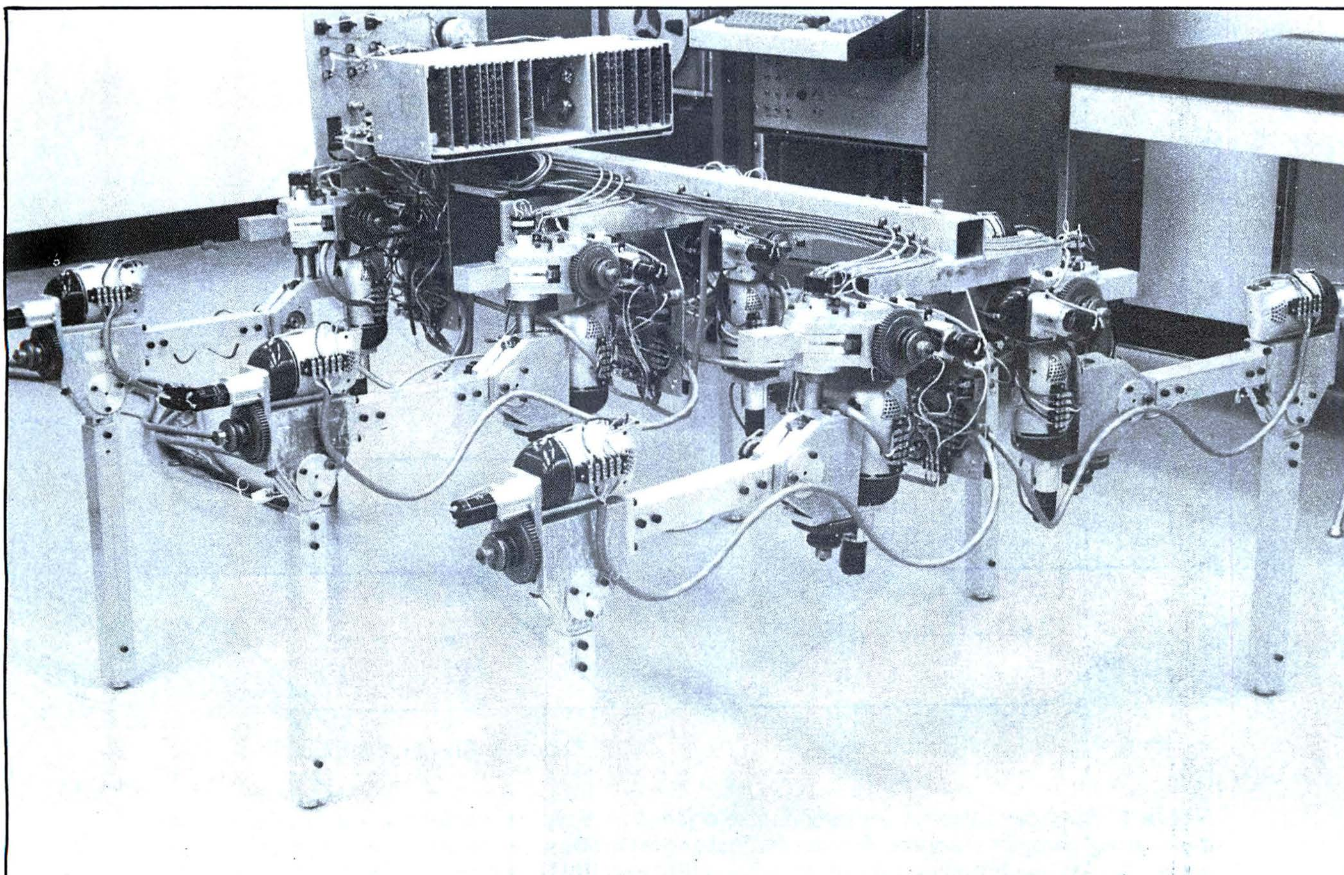
HEXAPOD

by Robert B. McGhee and
James R. Buckett
Department of Electrical Engineering, Ohio State University

PREFACE

The rapid technological advances of the past few years have enabled areas of research to emerge that were closed to all except imaginative science-fiction writers. One such concept was legged locomotion. It is now envisioned that in the future legged vehicles will perform tasks such as data collection on the ground of distant planets, walk the ocean floor, seek and destroy dangerous materials lodged in room mazes and provide an added dimension of mobility to handicapped persons.

* * * *



Hexapod, six-legged "bionic bug," is a prototype for larger machines to substitute for wheeled or tracked vehicles in fragile environments such as polar regions and forests.

It is commonplace knowledge that natural and artificial means for land locomotion have evolved along quite different lines. Animals accomplish locomotion either by utilizing systems of more or less independently-powered and controlled limbs while land-based vehicles generally rely upon wheels to achieve mobility. Because of the evident superiority of automotive and rail transportation compared to animals for moving heavy loads and attaining high speeds, it was thought that wheeled transport represents an inherently superior method of land locomotion. This view is now coming under question. Only the synergistic combination of smooth and hard surfaced roads or rails together with wheels yields this efficiency. Legged locomotion requires much less trail preparation with consequent permanent alteration of the trail site.

The apparent mobility advantages of legged locomotion systems relative to wheeled or tracked vehicles in off-road situations are based on empirical evidence and engineering analysis of soil characteristics, vehicle dynamics and costs. Results obtained from experiments with several legged vehicles have verified the predicted off-road capabilities of "walking machines"[1,2].

Why then are not legged vehicles in widespread use? The answer at present comes in three parts: a) Natural or aritificial legged locomotion systems are dynamically very complex. Comprehensive engineering theory of such systems is still lacking. b) The computational complexity of the co-ordination problem for walking over natural terrain is very great. New approaches to designs may be required to achieve economical and reliable vehicles that utilize articulated lever motion instead of rotary action. c) Efficient means for powering individual joints in articulated mechanisms are not yet available. The electric and hydraulic actuators typically used to provide joint torques for remote manipulators, industrial robots and related devices are grossly inferior to natural muscle and tendon systems.

Despite the present drawbacks, there is another compelling reason for studying the control aspects of legged locomotion: to develop the arts of lower extremity prosthetics and orthotics. The authors believe that the lack of development in those areas is substantially related to the problems mentioned above with respect to legged vehicles. These problems carry further complications which arise from very difficult man-machine interaction occurring when an assistive device is attached to a partially disabled human being.

There are, however, now several serious efforts underway to produce a workable system. With the ever-decreasing cost of microprocessors, along with the expanding base of theoretical knowledge about locomotion processes, there is reason to be optimistic concerning the long-term outlook for success in this area of research.

STABILITY OF LOCOMOTION

Nature evolved neural systems capable of dealing with extremely complex motions. The human body possesses around 200 rotational degrees of freedom powered by approximately twice as many muscle pairs. From an engineering point of view the functioning of this system is still poorly understood and studies of dynamics of human posture and control have resulted in the understanding of only from two to eleven degrees of freedom. A similar ignorance exists relative to animal locomotion. Great advances have been made in the areas of neurophysiology as applied to kinematics and kinetics of gaits, but even basic studies and dynamic models on the role of individual neurons in arthropod (insect) limb co-ordination have been rarely applied in the design of artificial legged systems.

Two principles of dynamics have been noted and ap-

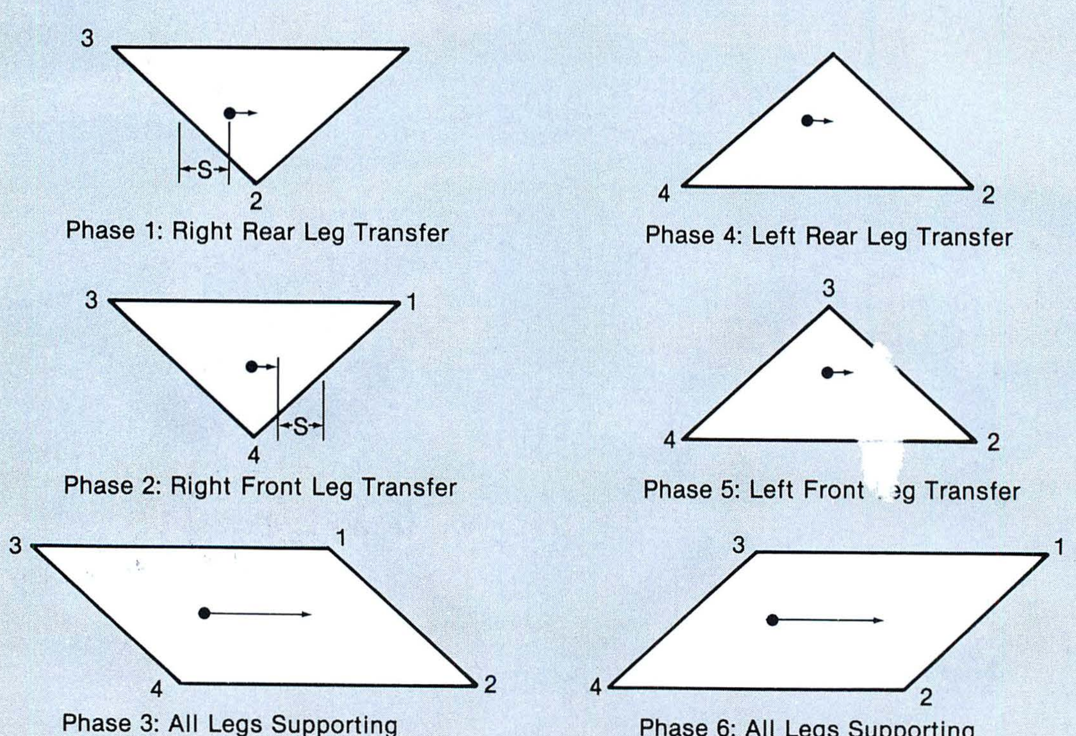


Figure 1. Support patterns for successive phases of a typical optimal quadruped crawl gait illustrating passive stability. Arrows indicate total motion of vertical projection of center of gravity during each phase. Longitudinal stability margin, S, is equal to the shortest distance over an entire circle of gait from the c.g. to an edge of the support pattern as measured in the direction of travel.

plied in the design of articulated mechanisms. First of all the relative displacement of body segments can be used to confine the center of pressure of the ground reaction forces experienced by the living creature to the interior of the "support pattern" formed by the feet in contact with the ground. Figure 1 illustrates this application of the principle to a quarduped system. Such gaits can be considered "passively" stable because any overturning moment will be countered by a corresponding restoring moment so long as the "stability margin" of the gait is not exceeded.

Arthropods invariably use gaits possessing passive stability; quadrupeds use such gaits only for very low speed motion. Passive stability dynamics is functional in biped locomotion only because bipeds possess rather large feet and in slow speed locomotion, humans and other bipeds normally confine the center of pressure of the ground reaction force to the footprint of one foot, or to the region between the feet in the double support phase of gait. This is the action which produces the side-to-side sway observed in normal human locomotion.

For higher speed biped and quadruped locomotion, the passive stability mode of control is abandoned. It is replaced by a mode in which control rests on the time and position of the placement of each foot. Computer simulations of feedback principles[3,4,5,6] have yielded answers. This is called "limit cycle" stability. Feedback signals are used to control the period and amplitude of the oscillation of the center of gravity of the system.

Two distinct approaches have been used to date to translate the natural dynamics into constructed systems. The first is to make use of neural control by assigning the stabilization function to a human operator. This method is appropriate in prosthetics and orthotics since the human being is unavoidably involved in the system. A simple example of this is the use of crutches or canes.

Manual control has also been used in a large quadruped vehicle by fitting the operator with a force-reflecting exoskeleton mounted in a vehicle cab[2]. It proved cumbersome and has since been abandoned.

The alternative to manual-control is to fit the artificial legged system with an "autopilot" to solve the stability problem automatically. This is still in the conceptual stage.

In 1961 Rajko Tomović published his observations on certain simple modes of locomotion which could be characterized by finite state models[7]. He observed that if each leg of a machine or animal is regarded as a two-state device, (on the ground or in the air) then the successive phases of gait can be regarded as successive states of a binary sequence generator. Control was later introduced into such models by postulating a four-state device called a "cybernetic actuator"[8]. The four states of the actuator are: free swinging, locked, powered forward rotation and powered rearward rotation. McGhee and Tomović conjectured in 1966 that very simple controllers could produce co-ordinated limb segment motions using such actuators[8].

In order to test the concept, a small artificial quadruped was constructed at the University of Southern California during a period form 1965 to 1968. This machine utilized a controller containing only 16 flip-flops and no analog control elements[9]. It successfully attained stable locomotion using two gaits, the crawl and the trot.

The success of the USC quadruped vehicle encouraged continuing work on finite-state control of locomotion, with emphasis on prosthetic and orthotic applications. Successful operation of a knee-joint controller for a leg brace was reported in 1972[10]. This system made use of an unpowered joint and possessed only two ac-

tuator states—locked and free-swinging—at the knee. The locking and unlocking action was accomplished by a simple switching circuit using a finite algorithm with feedback of the knee angle and hip angle of the affected limb. A more recent version uses a hydraulic knee locking device controlled by a microprocessor.

The microprocessor algorithm for bilateral control involves nine states and utilizes feedback from foot switches, knee and hip angle detectors and crutch-tip contact sensors to govern the transitions between control states.[10,11].

WHY HEXAPOD?

As we have seen there are many vehicle design alternatives. The designer is faced with the choice among many factors regarding size, shape, leg configuration and number of legs. The six-legged vehicle was chosen as a compromise amongst those several factors. Six legs provide ease of control, better static stability and reduced proportional load per leg. The design was modelled on typical arthropod (insect leg) geometry. A simplified version of this articulation is shown in Figure 2. This configuration has three degrees of freedom, one in the knee and two in the hip. All six joint actuators are identical.

The vehicle walks by incorporating the wave gait. The lifting and placing of the leg starts in the rear and moves forward along the side of the frame in opposing phase from side to side. The frame carries no payload, only the motor control and instrumentation electronics. Power and control are input via a trailing cable.

Long-range ambulation goals for the Hexapod are to design a vehicle which can climb stairs and slopes, will ride smoothly over rough terrain, bypass obstacles directly ahead, maneuver over large obstacles, cross ditches of length comparable to the vehicle length and maneuver in small spaces such as halls or stair landings.

The Hexapod leg can be also seen as an "arm." The leg possesses a two-degree-of-freedom hip joint and one-degree-of-freedom knee joint. Each joint is driven through a worm gear by an electric motor. It is necessary for each leg to be sufficiently strong to support its own weight, a portion of the vehicle body weight and the added load when its neighbour is raised. The output torque rating of the worm gear is 95 ft-lbs for a joint rotation rate of 2 rpm. The joint of the leg is capable of producing 300 ft-lbs for short periods of time at a very low angular rate.

The Hexapod locomotion system has been modelled and simulated on a PDP-10 computer in order to design the control system for the vehicle. Figure 6 shows the bias torque values for the elevation joint at the hip of each of the six legs over one locomotion cycle.

The stride length of the gait is three feet while the period is 18 seconds. Thus, the vehicle travelling on level terrain attains a speed of 1/6 foot/second. (See Figure 7.)

The Hexapod is automatically capable of negotiating stairs typical of those found in commercial and public buildings. The important consideration is that each foot should contact the steps without slipping during its supporting phase and that it does not contact the vertical surfaces of the staircase.

Designing slope-climbing ability into the machine involved a number of trade-offs, one of the most obvious was the length of the leg. The leg must be long enough to permit adequate reach in moving over rocky or pockmarked terrain, especially to clear large obstacles and wide ditches.

In slope-climbing, Figure 8 shows three different equilibrium leg-body configurations. The most obvious trade-off evident in this figure is one between stability and terrain adaptability, where terrain adaptability is measured as the ability of the legs to contact the supporting surface and stability relates to the degree in

which the vehicle can resist overturning moments. S represents the shortest distance in a horizontal direction from the vertical projection of the vehicle center of gravity to the edge of the support pattern. If α is the slope of the terrain, then stability margins for the three cases illustrated on Figure 8 is

Case 1: $S = b$

Case 2: $S = b \cos \alpha$

Case 3: $S = (b - z_o \sin \alpha) \cos \alpha$

$\qquad = b \cos \alpha - (z_o/\alpha) \sin 2\alpha$

where (b,c) is the distance of the hip socket of the end legs from the center of gravity of the body as measured in body co-ordinates and z_o is the perpendicular distance from the slope to the center of gravity of the body of the vehicle. From these equations, it is evident that the stability margin is greatest for Case 1. Case 3 gives the smallest stability margin and in fact leads to instability for the condition.

$$z_o > \frac{b}{\sin \alpha}$$

For large slopes, the only realistic way to keep the legs and body in the configuration illustrated in Case 3 would be to keep the "belly" of the vehicle close to the ground (small z_o). This may be inadequate over rough slopes since it is highly undesirable for the body to contact the ground.

If terrain adaptability is measured in slope-climbing as the ability of the legs to contact the supporting surface, then this criterion is optimized in the reverse order of the cases. The effective length of the back legs for Case 1 becomes exceptionally long for large slopes. On the other hand, the leg length for Case 3 varies the least over the gait cycle and does not depend upon the slope of the terrain.

In considering both stability margin and terrain adaptability, Case 2 seems to present a reasonable compromise between the extremes and may be preferable. The equilibrium position of the legs is along the gravity vector to give an adequate stability margin while the body is parallel to the supporting surface to allow reasonable foot placement. An interesting note is that a vertical sensor is necessary for Cases 1 and 2 so that the body or legs may be oriented with respect to the gravity vector.

CONTROL SYSTEMS

The control system for the Hexapod has been configured so that a human operator provides supervisory control over the vehicle. Figure 9 illustrates this arrangement. As can be seen, human operator functions include:

1) Mode selection: The operator sets an appropriate mode of locomotion so that the vehicle can successfully accommodate to the terrain.
2) Route selection: The operator chooses a path for the vehicle so that it may always be stable.
3) Speed: The operator, in response to terrain relief information and mission objectives, sets a desired speed.
4) Direction: The operator continuously controls the heading of the vehicle and the direction of motion of the body.

The computer is added to the system to unburden the human operator and to solve the simple vehicle control tasks automatically. These tasks include:

1) Gait implementation: A gait is selected which allows the vehicle always to be stable.
2) Body and leg trajectory synthesis: The commands furnished by the operator are accepted and body pitch, roll, and height are automatically regulated. The legs trajectories are synthesized for the desired motion. Foot placement points (support points) vary to accommodate the terrain.

3) Active force control: The joint torques are controlled to move the vehicle in the desired trajectory, to minimize system energy, to equalize the loading among the supporting legs, and to eliminate foot slippage on slippery surfaces.

In structuring the control computer software, two considerations are important. First, the software should be divided into modules that solve subproblems of the total locomotion task. In this way, the problem is broken down into a manageable form. Appropriate mathematical techniques and programming algorithms may be more easily applied to solve these subproblems. Such modularized software also provides the necessary simplicity to permit relatively easy debugging and to enhance reliability during operation.

The second important consideration is that interactions between the program modules should be minimized. Interactions tend to be costly in computation time. Minimizing interactions also simplifies the effective implementation.

The attempt to break the control software into program modules with minimum interaction between the modules, the independent local controllers, is also biologically motivated. Animals that are low on the evolutionary scale, such as insects, solve the locomotion task by controlling each leg rather independently.

A block diagram of the control computer software system for the Hexapod is presented in Figure 10. As can be seen, this approach amounts to hierarchical control in which the more general and complex problems are solved at the top while the lower levels solve the more structured problems. For this particular system, the tasks assigned to the control computer are solved by considering the three locomotion criteria — stability, terrain adaptability and energy consumption — in a sequential manner.

CONTROL IMPLEMENTATION

OPTIMIZATION OF STABILITY — As previously stated, while many animals and man are able to attain stability of motion with gains containing statically unstable phases, to date all successful legged vehicles have made use of gaits such that static stability is realized at every instant of time. Among such gaits, certain ones possess greater degrees of stability than others. That is, for a specified vehicle body trajectory over a given terrain, the support points chosen for placing each foot, and the timing of foot placing and lifting events, determine the minimum static overturning moment required to upset the vehicle at any point in a particular cycle of locomotion. While this aspect of vehicle stability has been considered for uneven terrain[12], optimal solutions are not as yet available. On the other hand, for constant speed straight-line locomotion over level terrain, maximization of minimum overturning moment in the direction of travel has been formulated in terms of a nonlinear programming problem and the best gaits are known. For six-legged locomotion, as by the Hexapod among vehicle systems and by insects in nature, the optimal gait is a *symmetrical* mode defined by the following equation:

$$\phi_3 = \beta, \phi_5 = 2\beta\text{-}1, \beta \geqslant .5$$

where ϕ_3 is the time delay of the left middle leg and ϕ_5 is the delay of the left rear leg, both measured as a fraction of a total leg cycle and relative to the placing of the left front leg, and "symmetrical" means that the relative time delay of the right side legs are each one-half of a cycle out of phase with the adjacent left side leg (see Figure 11). The above equation describes the family of *wave gaits* in which a wave of placing events runs from the rear to the front along either side of an animal or vehicle with a constant time interval between the action of adjacent legs on the same side. Such gaits are used by all arthropods as well as by slow-moving quadruped vertebrates.

At present, optimal gaits for other than straight-line locomotion are not known. For the present, the control programs for the Hexapod merely modify the spatial aspects of wave gaits to accommodate turning behavior and uneven terrain. While such gaits have good stability properties, further research may show that they are not optimal.

With the temporal aspects of gait defined by the above equation which gives the phase relationships among the legs and the leg duty factor, there is still freedom to choose the exact foot placement points, body trajectory, and leg transfer kinematics. These are computed to accommodate the terrain while responding to the operator's input. In the following paragraphs, the algorithms that have been programmed to generate the system kinematics are outlined. With the algorithms already programmed, the simulated vehicle is able to travel in any direction and head over an undulating terrain with an overall slope while automatically adjusting its body height, pitch, and roll for terrain variation.

MODE CONTROL: To achieve this function, the operator furnishes a discrete input to the computer through a keyboard to determine the mode of locomotion. Available computer modes include the functions given in Table I. Presently the first two modes have been implemented in a computer simulation. Vector velocity control is used to maneuver around obstacles without changing the heading of the vehicle. Turning control is much like that in an automobile and is helpful in routine locomotion. The other control modes are expected to be implemented in the near future.

Table I: Typical Control Computer Modes

Mode	Function
Vector Velocity Control	The heading of the vehicle remains constant while the center of gravity of the vehicle moves as commanded by two axes of a joystick.
Turning Control	The heading turns with a rate commanded by one axis of a joystick and the forward (backward) velocity in the direction of the heading is determined by the position of the other axis of the joystick.
Follow-the-Leader Control	The operator manually places the front foot on each side and the others follow in these footprints as the vehicle moves forward.
Manual Control	The operator exercises individual control over each leg in a sequence determined by the operator.
Stairclimb Control	The operator controls speed and direction and also provides step length and height inputs.

BODY HEIGHT, PITCH, AND ROLL REGULATION: Certain of the elements of the body state are determined from commands furnished by the operator. In vector velocity control, the forward/backward velocity in the direction of the heading and sidestep velocity are directly controlled by the operator through a two-axis joystick. In turn control, the forward/ backward velocity and the azimuth turning rate are steered. In both modes, the body height above the supporting surface and the body pitch and roll angles are automatically adjusted by the computer to accommodate the terrain.

The algorithm for automatic body height, pitch, and roll regulation determines the desired values for these variables by fitting an approximate plane to the points of support by a least-squares method. The body is then commanded to be parallel to this estimated support plane and at a constant perpendicular height above it.

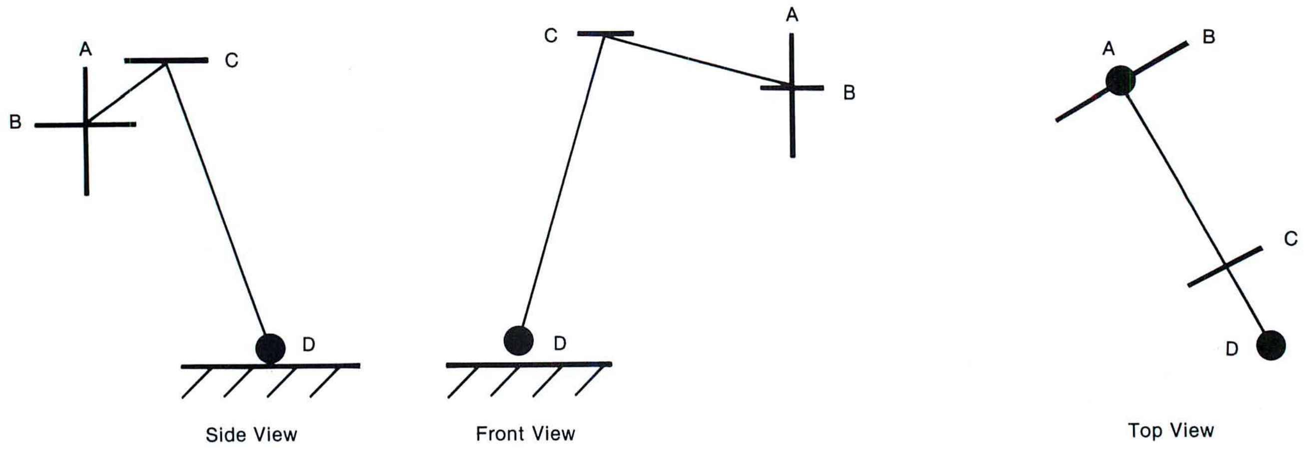


Figure 2. Simplified Arthropod Leg Geometry (Leg Extended Forward)

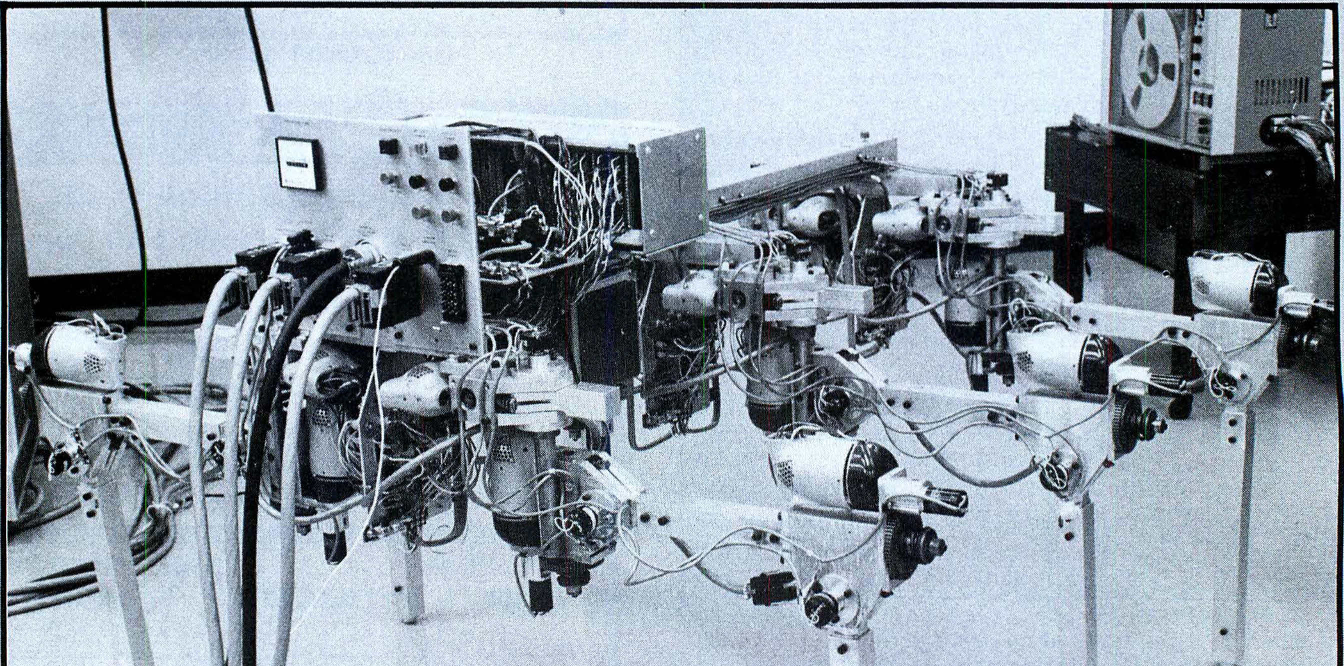


Figure 3. Front view of Hexapod Vehicle. Length = 1.3 m, Width = 1.4 m, total weight exclusive of cables = 103 kg.

INTRODUCING THE COMPLETE CHALLENGER SYSTEM.

OSI's DREAM MACHINE
is a totally integrated computer system.

Imagine a system complete with terminal, CPU, memory, floppy disk, software, and all the little necessities to make it work together immediately. Now imagine this complete system available not only fully assembled, but priced much lower than anyone else's kit. What you are dreaming of is OSI's "new" Challenger System!

In the configuration shown above, the Challenger includes everything an end user needs for a complete small computer system. All you add is 110 VAC power and a desk to put it on.

This fully-assembled system includes:

HARDWARE:

OSI Challenger 65 with 16K RAM, serial interface, system monitor PROM, and floppy disk bootstrap PROM.

OSI Challenger single drive floppy disk formatted for 250K bytes storage per diskette surface.

Stand-alone terminal and Sanyo monitor for 16 lines of 64 characters at 2400 baud (other terminal options are available).

And all interconnecting cables!

SOFTWARE:

2 diskettes containing over 100,000 bytes of software including OSI's powerful Disk Operating System with variable length sectors. **6502 DISK BASED RESIDENT ASSEMBLER/EDITOR!** A totally interactive Assembler/Editor which assembles up to 600 lines a minute and is completely compatible with MOS Technology's Cross Assembler format. This program also contains a powerful disk-based line editor with commands for general text editing. **OSI'S EXTENDED MONITOR:** A powerful machine language debugging and utilities package including a Disassembler which is format compatible with the Assembler! **OSI 6502 8K BASIC FOR DISK BY MICROSOFT:** This powerful BASIC has all the features of Altair® 8K BASIC for the 8080 plus higher speed and disk storage. And it comes complete with a BASIC program library.

DOCUMENTATION AND SUPPORT:

We include over 600 pages of hardware, software, programming, and operation manuals. The Challenger is based on the well-proven OSI 400 system. The over 2,000 OSI 400s and Challengers now in use assure continuing hardware and software support for this system for years to come!

EXPANDABILITY:

The Challenger System can now be expanded to 192K of RAM and 16K of I/O and ROM. There are over 13 accessory boards including A/D, D/A, parallel and serial I/O, cassette interfaces, a dual drive floppy, a video graphics display, several RAM and PROM boards, and multiple-processor configurations.

APPLICATIONS:

The Challenger system is complete, fully assembled and configured so that the Disk Operating System can be booted in immediately on system power-up. Even a relatively inexperienced operator can have a complex BASIC program on-line just seconds after the system is turned on. The ease of use, high reliability, and large library of standard BASIC applications programs make the OSI Challenger System the first practical and affordable small computer system for small business, educational institutions, labs, and the personal computerist.

PRICES:

Challenger System, complete as stated above with terminal and monitor

$2599.00

As above without terminal. Specify RS-232 or 20ma loop and baud rate

$2099.00

IMPORTANT NOTE:

One of the most important features of the Challenger System is that it is not really "new". OSI has been delivering the basic circuitry of the Challenger since November 1975 and the floppy disk since June 1976. The only thing new is the total integration of the components as a complete, simple to use, fully-assembled, small computer system.

For more free information and the address of the OSI Computer Dealer or representative in your area, write to: OSI; Dept. S; Hiram, Ohio 44234 or enclose $1.00 for the full OSI catalog which contains kits from $134 and fully assembled computers from $439.

OHIO SCIENTIFIC

Hiram, Ohio 44234

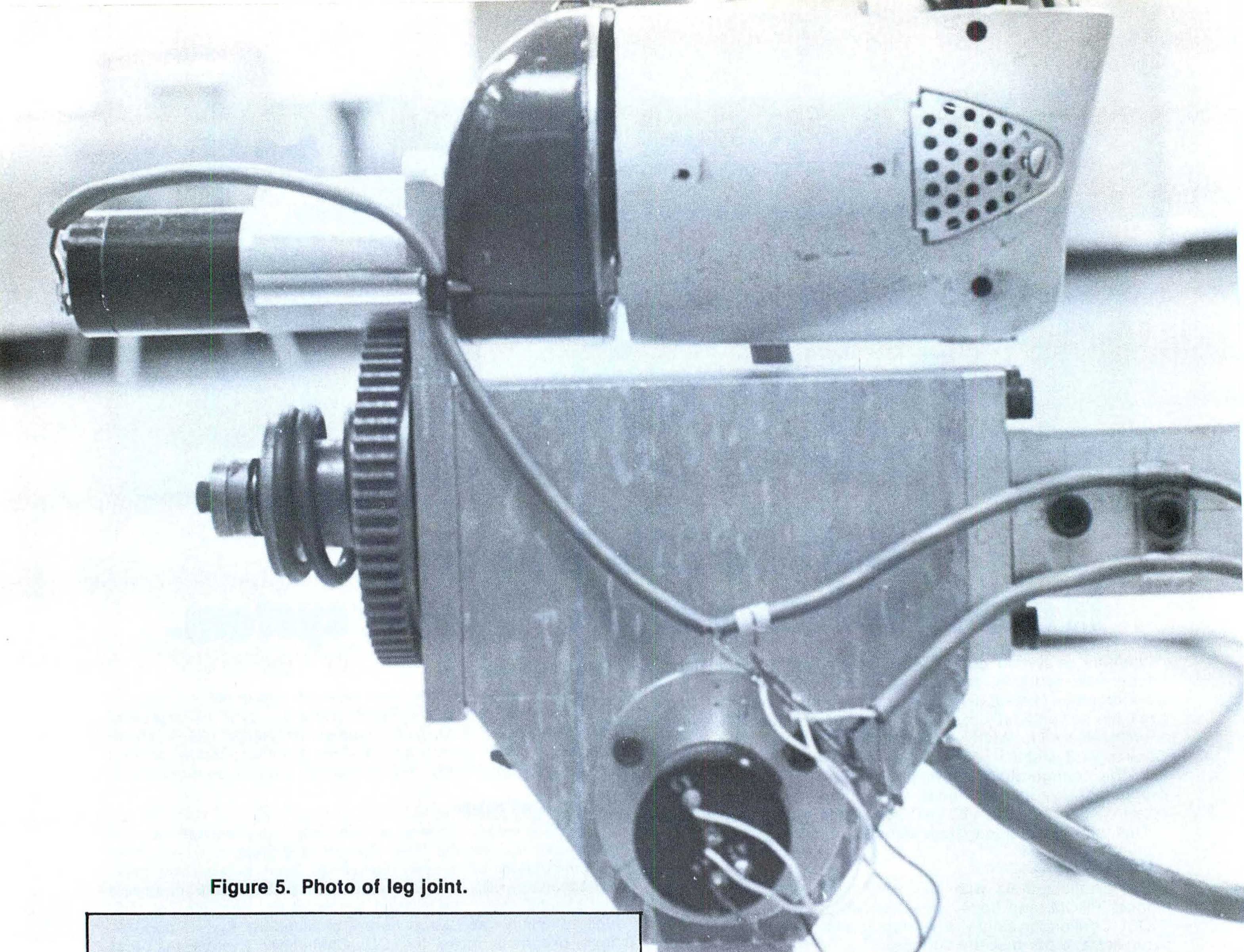


Figure 5. Photo of leg joint.

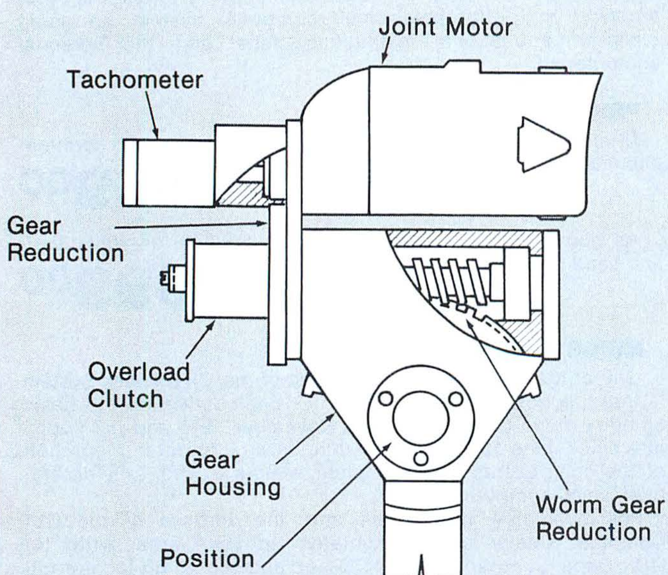


Figure 4. Mechanical Drawing Showing the Elements of a Leg Joint.

AUTOMATIC LEG POSITIONING: With the desired state of the body generated by the previous algorithms, it is necessary to implement the optimum wave gait and to define leg trajectories that move the body along the desired path. For any specific value of the duty factor, β, this gait may be alternatively described by a particular *event sequence* showing the successive lifting and placing events in one leg cycle. One such example, the parallelogram gait, is shown in Figure 11. By investigating such event sequences, it may be found that as the duty factor increases from 0.5 to 1.0, more legs are in contact with the ground over a gait cycle. These relationships are shown in Table II. Given such an event sequence, it remains to specify certain of the spatial aspects of gait. In particular, in order to implement the wave gait for a given duty factor, a gait *period* and *stride length* must be specified. The stride length, λ, is previously defined for straight-line locomotion as the distance by which the body is translated in one complete locomotion cycle of gait while the period is the time between successive placing events for a given leg. In this research, the definition of stride length has been generalized to include the case of arbitrary locomotion over a surface as follows:

λx = the desired longitudinal distance by which the body is to be translated in one complete locomotion cycle.

λy = the desired lateral distance by which the body

The POLY 88 Microcomputer System

PolyMorphic Systems now offers the complete, assembled, personal computer system—the POLY 88 System 16. A full 16K system with high speed video display, alphanumeric keyboard, and cassette program storage. A BASIC software package providing the most advanced features available in the personal computing market. Features like PLOT and TIME, which utilize our video graphics and real-time clock. Others like VERIFY, so that you know your tape is good before you load another. Or input type-ahead so you can tell your program to run while the tape is still loading (it stores up to 64 characters of commands or question responses to be executed). All these plus a complete package of scientific functions, formatting options, and string capabilities. With the POLY 88 System 16 you can amaze your timesharing friends the very first night!

Polymorphic Systems 11K BASIC — Size: 11K bytes.

Scientific Functions: Sine, cosine, log, exponential, square root, random number, x to the y power.

Formatted Output • Multi-line Function Definition • String Manipulation and String Functions • Real-Time Clock • Point-Plotting on Video Display • Array dimensions limited by memory • Cassette Save and Load of Named Programs • Multiple Statements per Line • Renumber • Memory Load and Store • 8080 Input and Output • If Then Else • Input type-ahead.

Commands: RUN, LIST, SCR, CLEAR, REN, CONTINUE

Statements: LET, IF, THEN, ELSE, FOR, NEXT, GOTO, ON, EXIT, STOP, END, REM, READ, DATA, RESTORE, INPUT, GOSUB, RETURN, PRINT, POKE, OUT.

Built in Functions: FREE, ABS, SGN, INT, LEN, CHR$, VAL, STR$, ASC, SIN, COS, RND, LOG, TIME, WAIT, EXP, SQRT, CALL, PEEK, INP, PLOT.

Systems Available. The POLY 88 is available in either kit or assembled form. It is suggested that kits be attempted only be persons familiar with digital circuitry.

System 2: is a kit consisting of the POLY 88 chassis, CPU, video circuit card, and cassette interface. Requires keyboard, TV monitor, and cassette recorder for operation. $735

System 16: consists of an assembled and tested System 2 with 16K of memory, keyboard, TV monitor, cassette recorder, 11K BASIC and Assembler on cassette tapes. $2250.

System 0: The circuit cards an S-100 mainframe owner needs to be compatible with the POLY 88 software library. System 0 consists of the central processor card with monitor ROM, the video circuit card, and cassette interface, all in kit form. $525.

Prices and specifications are subject to change without notice.
California residents add 6% sales tax.

460 Ward Drive
Santa Barbara, Ca. 93111
(805) 967-2351

PolyMorphic
Systems

is to be translated in one complete locomotion cycle.

$\lambda\Psi$ = the desired azimuth rotational arc by which the body is to be rotated on one complete locomotion cycle.

In the case of constant speed straight-line locomotion, longitudinal velocity (μ) is simply related to λx and τ by the equation

$$\mu = \frac{\lambda x}{\tau}$$

For general locomotion, there are two other velocities which can be defined, namely lateral velocity v, and turning velocity r. In case v and r are constant

$$v = \frac{\lambda y}{\tau}$$

$$\varrho = \frac{\lambda \Psi}{\tau}$$

These equations show that stride and velocity cannot be independently specified. Moreover, all of λx, λy, $\lambda\Psi$ are subject to upper-bound constraints imposed by leg

Table II
Relationship Between Duty Factor and Number of Supporting Legs for Optimal Wave Gait

Duty Factor Range	Number of Supporting Legs
$\beta = 1/2$	3 (tripod gait)
$1/2 < \beta < 2/3$	3 or 4
$\beta = 2/3$	4 (parallelogram)
$2/3 < \beta < 5/6$	4 or 5
$\beta = 5/6$	5
$5/6 < \beta < 1$	5 or 6

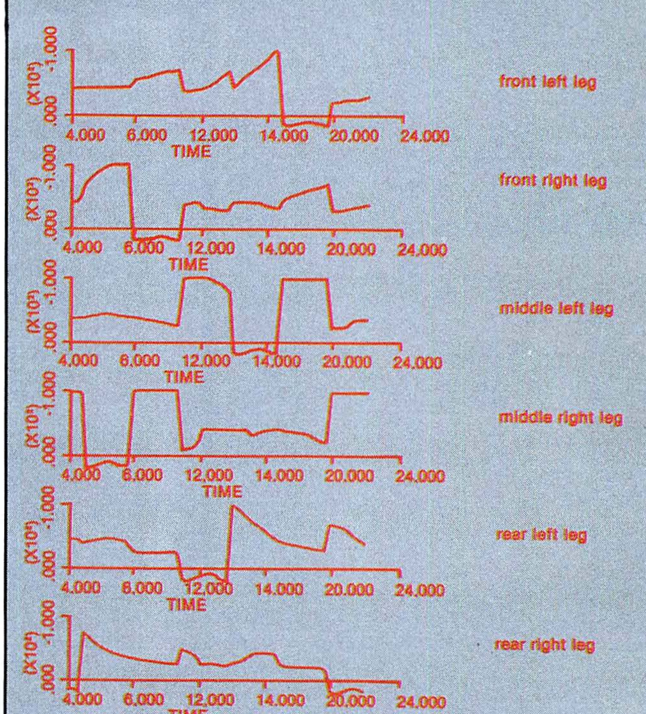


Figure 6. Bias Torques for the Elevation Joint at the Hip of the Six Legs of the OSU Hexapod Given Over a Locomotion Cycle. (Torque in foot pounds, time in seconds).

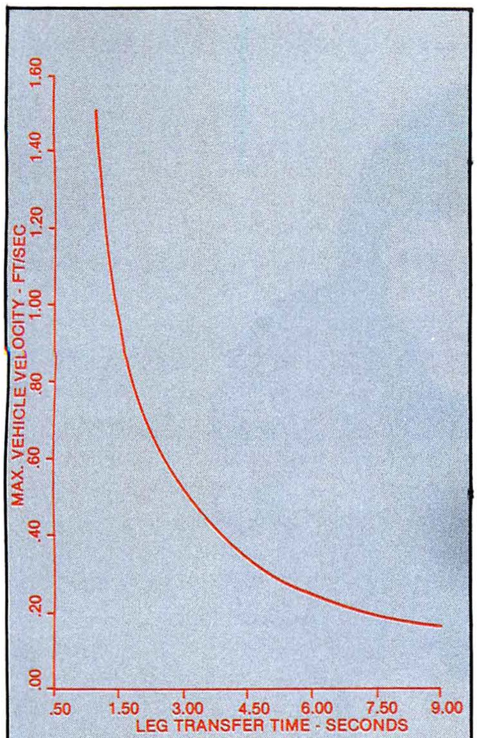


Figure 7-a. Maximum Vehicle Velocity as a Function of the Leg Transfer Time for a Stride Length of Three Feet.

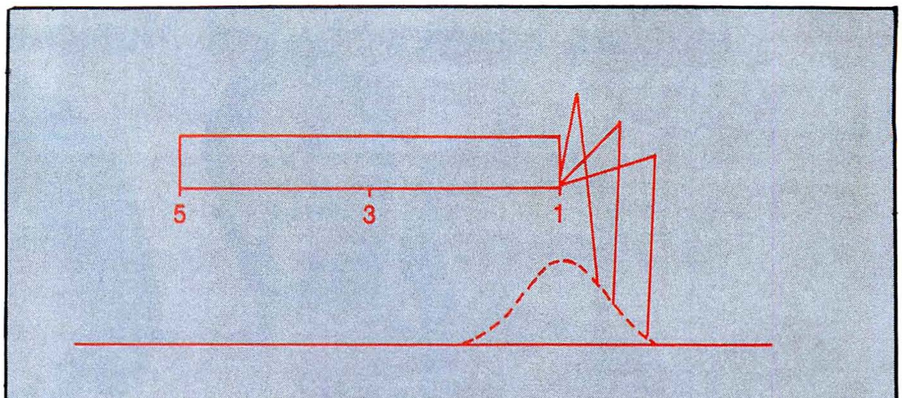


Figure 7-b. Side-View of the Body-Leg System Showing Leg 1 (left front) in the Transfer Phase

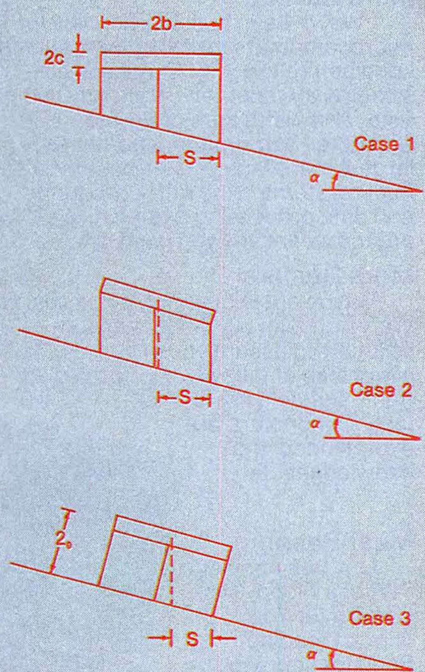


Figure 8. Three Potential Leg-Body Configurations for Slope-Climbing.

length, terrain relief, etc. Thus, if μ, v, and r are all specified, in general only one of the desired strides can be realized. The other two will be less than the desired values. This conflict is resolved in the control program for the Hexapod by defining

$$\tau_1 = x/\mu,\ \tau_2 = \lambda\Psi/r,\ \tau_3 = \lambda y/v$$

and then choosing

$$\tau = \min(\tau_1, \tau_2, \tau_3)$$

With this rule, if $\tau_1 = \tau$, then the associated stride variable will have the desired value while the other two strides will be shortened.

Similar to that which is evidenced in nature, in the control programs developed to date for the experimental vehicle, the duty factor is allowed to yield a constant leg transfer or return a variance time, τ_R. That is, with the gait period equal to τ, then the governing relationship used in this work is

$$\beta = (\tau - \tau_R)/\tau$$

where τ_R is regarded as being independent of vehicle velocity.

With the stride length, period, and duty factor given, the exact trajectory of the legs in the transfer phase must be specified. Again noting the event sequence diagram in Figure 11, leg 1 is in the transfer phase as time proceeds around the periphery of the circle from i + 6 to i. Figure 7-b shows one way that the leg could be moved during this phase. The foot is placed so that leg motion during the support phase will be one-half of a longitudinal stroke distance in front of the equilibrium position. (The longitudinal stroke is the distance the body moves forward when the foot is on the ground.) Similarly, the foot is placed one-half of a rotational stroke distance away from the equilibrium position for turning and one-half of a lateral stroke distance to the side for side-step.

For forward and sideways leg motion during the transfer phase, the foot moves linearly with respect to time from liftoff to placement. One type of vertical motion for the leg is shown in Figure 7b which describes a full sine trajectory. If the foot contacts any object above the anticipated touch down point, then the trajectory is interrupted and the foot remains at that point during the support phase. If there is a hole in the terrain at the anticipated touch down point, then the foot is incrementally lowered until it contacts the terrain.

While the above strategy was used for foot trajectory generation in the simulation study for the Hexapod, some changes are indicated when leg inertia is taken into account. Discontinuities in desired velocity should be avoided when they occur at leg placing and leg lifting. Such improvements are presently being implemented.

FOOTNOTES

1. Morrison, R.S., "Iron Mule Train," *Proceedings of Off-Road Mobility Research Symposium,* International Society for Terrain Vehicle Systems, Washington, D.C., June 1968, pp. 381-400.
2. Mosher, R.S., "Exploring the Potential of Quadruped," SAE Paper No. 690191, presented at the International Automotive Engineering Conference, Detroit, Michigan, January 1969.
3. Gubina, F., Hemami, H., and McGhee, R.B., "On Dynamic Stability of Biped Locomotion," *IEEE Trans. on Biomedical Engineering,* Vol. BME-21, No. 2, March 1974.
4. Gubina, F., "Stability and Dynamic Control of Certain Types of Biped Locomotion," *Proc. of Fourth International Symposium on External Control of Human Extremities,* Dubrovnik, Yugoslavia, August 28-September 2, 1972.
5. Hemami, H., and Lee, Y.H., "Stabilization of a Quadruped Locomotion System by Side Step Control," *Journal of Terra-mechanics,* Vol. 12, No. 2, June 1975.
6. Vukobratović, M., Frank, .A., and Juricić, D., "On the Stability of Biped Locomotion," *IEEE Trans. on Biomedical Engineering,* Vol. 17, No. 1, pp. 25-36, January 1970.
7. Tomović, R., "A General Theoretical Model of Creeping Displacement," *Cybernetics,* IV, pp. 98-107 (English translation), 1961.
8. Tomović, R., and McGhee, R.B., "A Finite State Approach to the Synthesis of Bioengineering Control Systems," *IEEE Trans. on Human Factors in Electronics,* Vol. HFE-7, pp. 65-69, June 1966.
9. Frank, A.A., *Automatic Control Systems for Legged Locomotion Machines,* Ph.D. dissertation, University of Southern California, Los Angeles, California, May 1968.
10. McGhee, R.B., Tomović, R., Yand, P.Y., and MacLean, I.C., "An Experimental Study of a Sensor-Controlled External Knee Locking System," to appear in *IEEE Trans. on Biomedical Engineering,* 1977.
11. McGhee, R.B., and Tomović, R., *Application of Logical Control with Sensor Feedback to a Prosthetic Knee Locking Device,* Technical Note No. 19, Communication and Control Systems Laboratory, The Ohio State University, November, 1975.
12. Okhotsimsky, D.E., Golubev, Yu.F., and Alekseva, L.A., "Stabilization Algorithm for Automatic Walking Machine," *Proc. of IV IFAC Symposium on Automatic Control in Space,* Takahkadzor, Armenian SSR, USSR, August 1974.

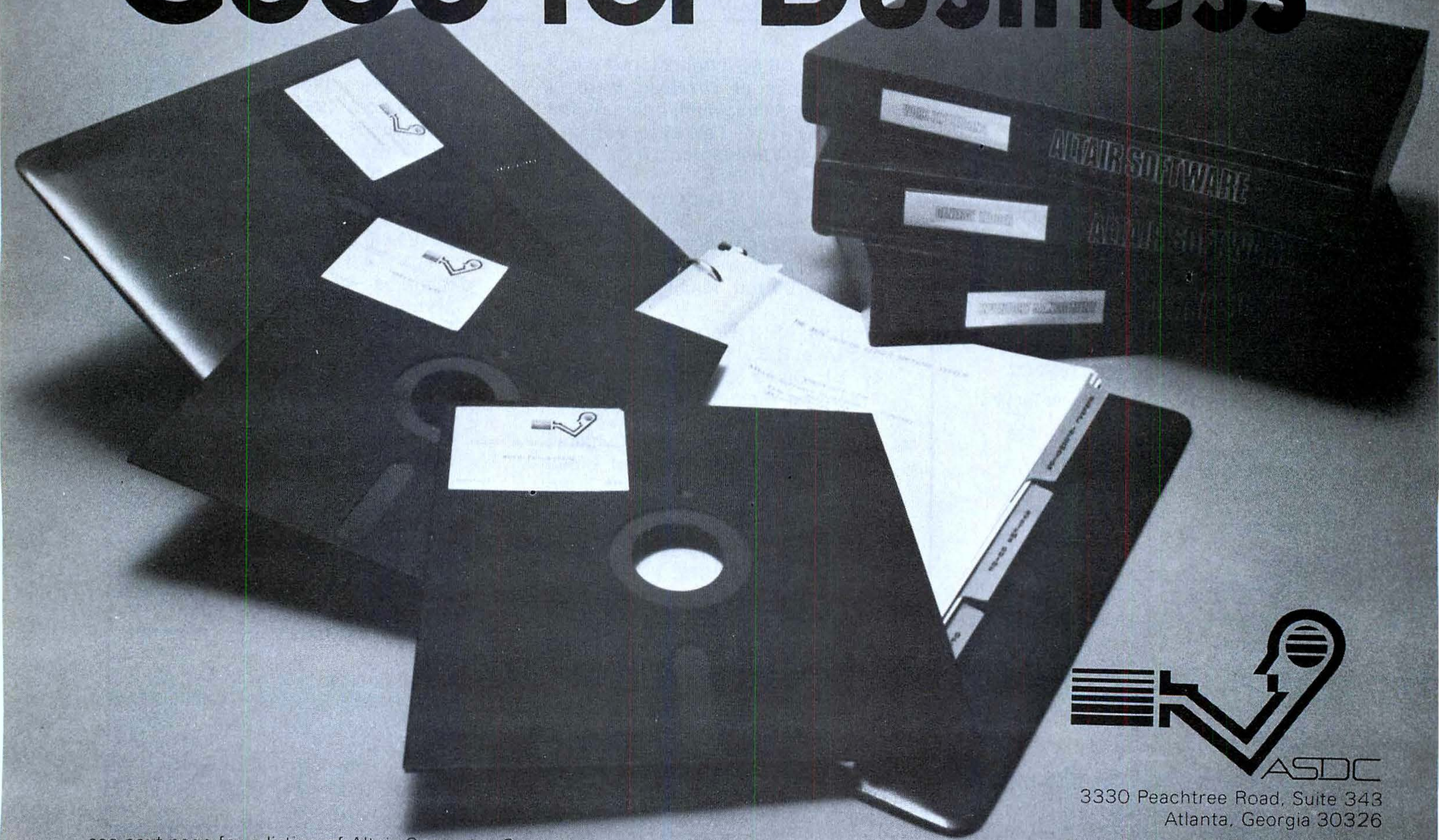
How does a small business fully realize the cost-effectiveness of a microcomputer? One major consideration is the right software. And the right office software is now available at all **Altair™ Computer Centers.** It's the **Altair Business System**—a total office management software package for all Altair 8800-based systems.

The **Altair Business System** brings accounting, word processing and inventory management software into your office at a surprisingly low cost.

The accounting packages include a flexible **general ledger** package that allows a business to keep a timely, detailed general ledger of all transactions and provide up-to-date financial reports for management. Packages for **receivables, payables** and **payroll** functions keep subsidiary ledgers current and produce automatic invoicing statements, check writing, 941s, W-2s and other required reports. The **word processing** system is an extremely flexible text editor that allows large volume text material, such as contracts, to be easily modified and printed. In addition, documents can call for inserts from other files, making repetitive letters very easy to produce. The **inventory management** system is an extremely flexible data base that allows complete inventory records to be kept on line. The package is designed to permit custom structuring of inventory files and reports.

Do something good for your business. Contact your local **Altair Computer Center** or the **Altair Software Distribution Company** directly for more information about the **Altair Business System.**

Good for Business



ASDC
3330 Peachtree Road, Suite 343
Atlanta, Georgia 30326

A subsidiary of MITS

see next page for a listing of Altair Computer Centers

CIRCLE INQUIRY NO. 40

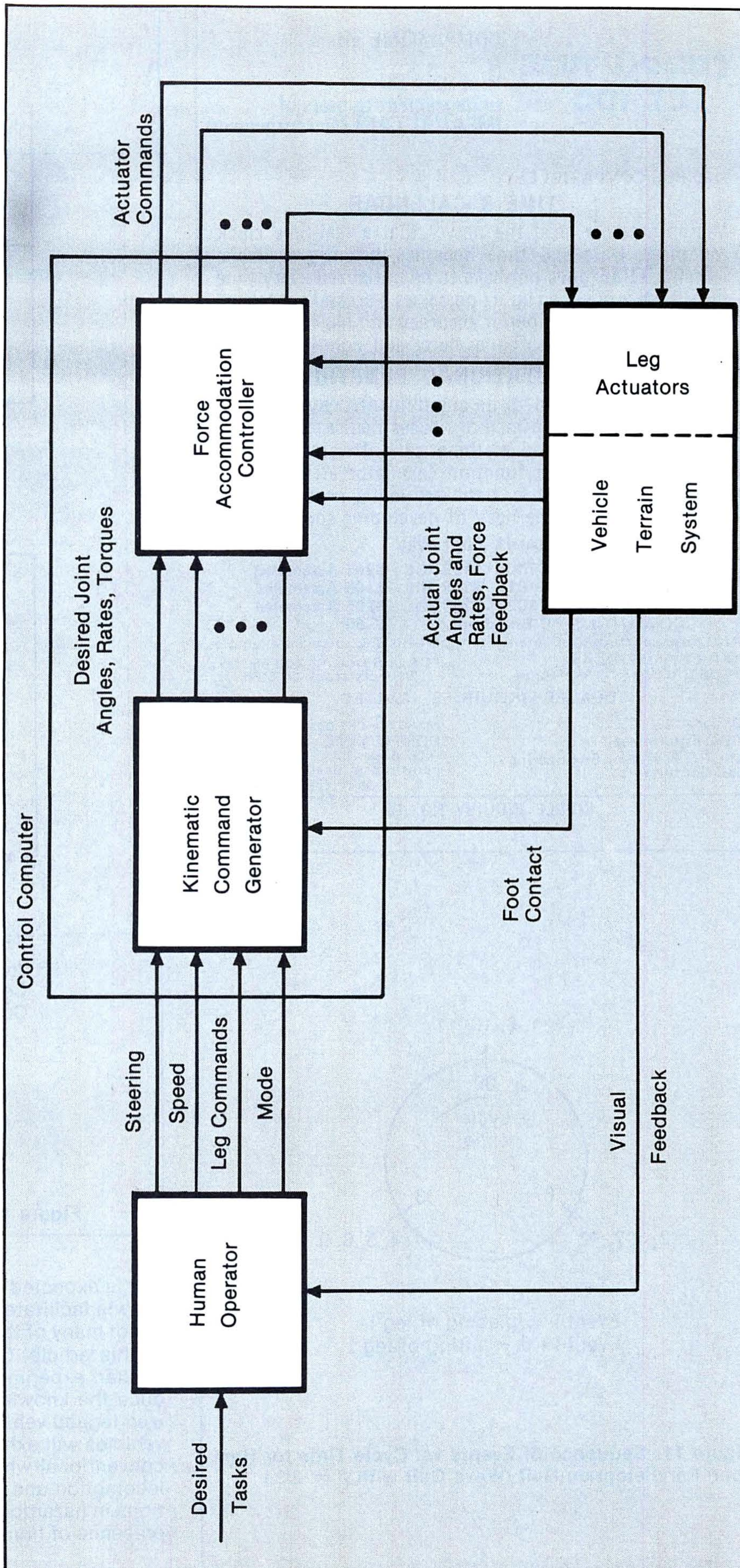


Figure 9. Ohio State University Hexapod Control System Information Flow Block Diagram.

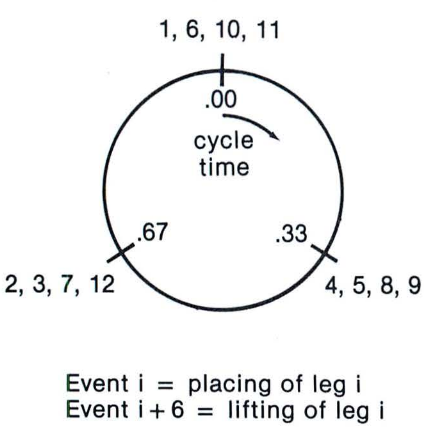


Figure 11. Sequence of Events vs. Cycle Time for Hexapod Parallelogram Gait (Wave Gait with β = 2/3.)

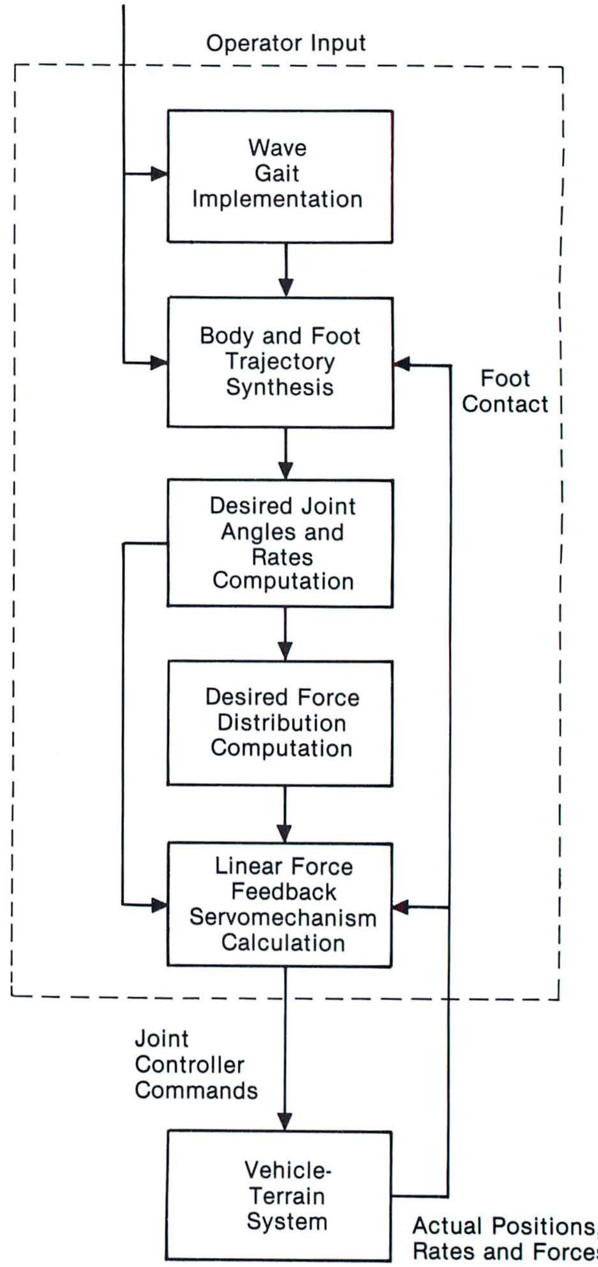


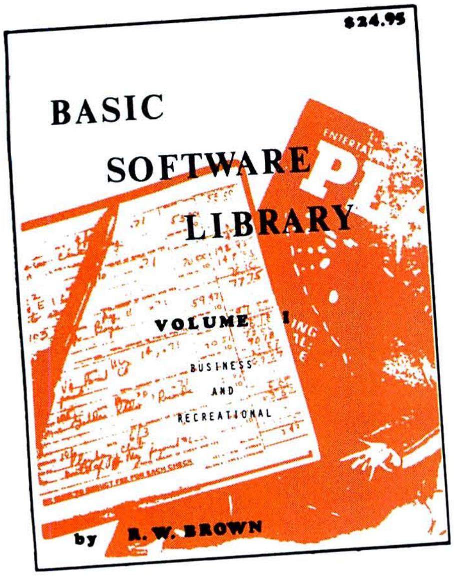
Figure 10. Control Software Hierarchy

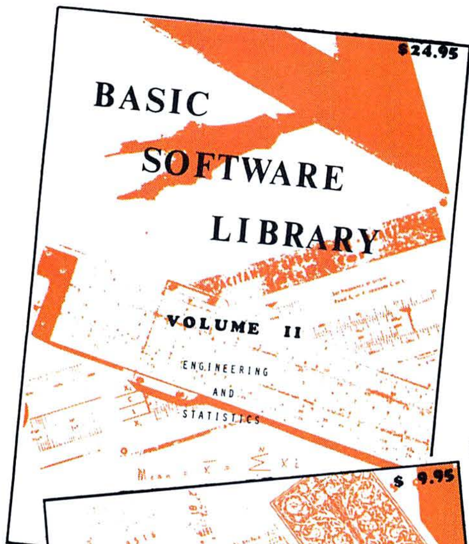
It is expected that the availability of a laboratory vehicle will facilitate the attainment of a deeper understanding of many of the problems which have been discussed in this article. Continued work with the Hexapod and similar experimental systems should eventually produce the knowledge needed for the design of specialized legged vehicles for specific tasks. Hopefully, such vehicles will exhibit mobility characteristics superior to conventional wheeled or tracked conveyances for land locomotion and will in the future permit remote operations in hazardous environments presently requiring the presence of human workers.

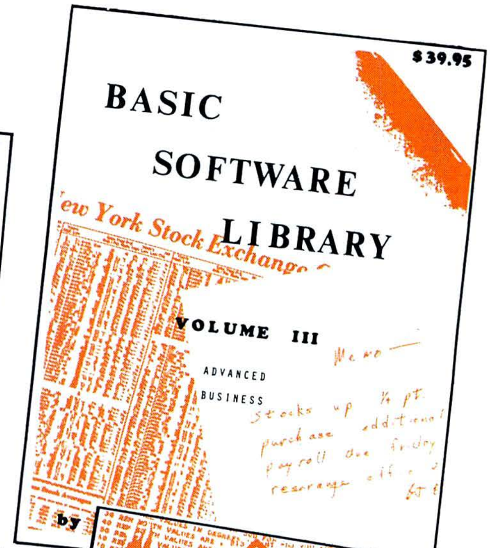
FANTASTIC SOFTWARE

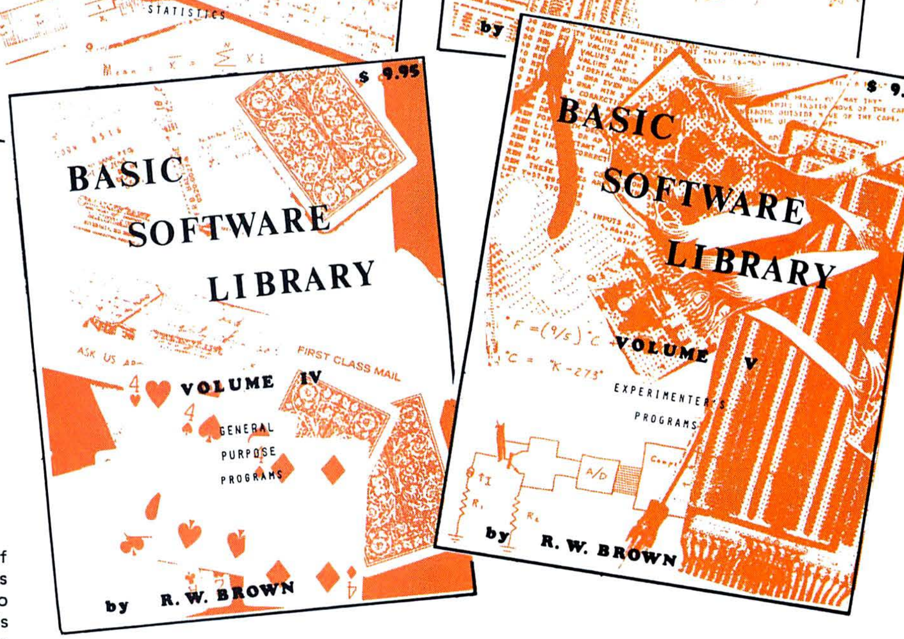
This LIBRARY is a complete do it yourself kit. Knowledge of programming not required. EASY to read and USE.

Almost FREE Less Than $1 / Program Complete









VOLUME I BOOKKEEPING GAMES PICTURES	..$24.95
VOLUME II MATH & ENGINEERING PLOTTING & STAT BASIC STATEMENT DEF	..$24.95
VOLUME III ADVANCED BUSINESS BILLING INVENTORY PAYROLL	..$39.95
VOLUME IV GENERAL PURPOSE	..$9.95
VOLUME V EXPERIMENTER	..$9.95

This library is the most comprehensive work of its kind to date. There are other software books on the market but they are dedicated to computer games. The intention of this work is to allow the average individual the capability to easily perform useful and productive tasks with a computer. All of the programs contained within this Library have been thoroughly tested and executed on several systems. Included with each program is a description of the program, a list of potential users, instructions for execution and possible limitations that may arise when running it on various systems. Listed in the limitation section is the amount of memory that is required to store and execute the program.

Each program's source code is listed in full detail. These source code listings are not reduced in size but are shown full size for increased readability. Almost every program is self instructing and prompts the user with all required running data. Immediately following the source code listing for most of the programs is a sample executed run of the program.

The entire Library is 1100 pages long, chocked full of program source code, instructions, conversions, memory requirements, examples and much more. ALL are written in compatible BASIC executable in 4K MITS, SPHERE, IMS, SWTPC, PDP, etc. BASIC compilers available for 8080 and 6800 under $10 elsewhere.

Available NOW ! ! ! at most computer stores

The "HOW-TO-DO IT" Books for the "DO-IT" Person

Written in compatible BASIC immediately executable in ANY computer with at least 4K, NO other peripherals needed.

See Our List Of Dealers

Add $1.50 per volume for postage and handling.

SCIENTIFIC RESEARCH

SRI

master charge

1712-I FARMINGTON COURT
CROFTON MD 21114
Phone Orders call (800) 638-9194

BANKAMERICARD

Information and Maryland Residents Call (301)-721-1148

Personal checks — allow 4 weeks tor shipping. Pricing subject to change without notice. If air mail shipping is desired add $3 per volume to price, Continental U.S. only. Foreign orders add $8 for each volume.

One Sol-20 equals three computers.

To do real work with any computer, big or small, it takes a complete system. That's one of the nice things about the Sol-20. It was built from the ground-up as the heart of three fixed price computer systems with all the peripheral gear and software included to get you up and on the air.

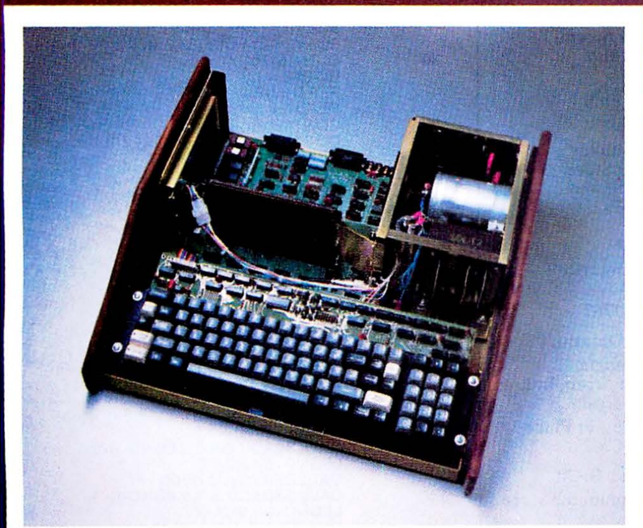
Sol System I costs just $1649 in kit form or $2129 fully burned in and tested. Here's what you get: a Sol-20 with the SOLOS personality module for stand alone computer power, an 8192 word memory, a 12" TV/video monitor, a cassette recorder with BASIC software tape and all necessary cables.

Sol System II has the same equipment plus a larger

capacity 16,384 word memory. It sells for $1883 in kit form; $2283 fully assembled.

For even more demanding tasks, Sol System III features Sol-20/SOLOS, a 32,768 word memory, the video monitor, Helios II Disk Memory System and DISK BASIC Diskette. Price, $4237 in kit form, $5037 fully assembled and tested.

And remember, though we call these small or personal computer systems, they have more power per dollar than anything ever offered. They provide performance comparable with mini-computer systems priced thousands of dollars more.



The functional beauty of Sol Computer Systems is more than skin deep. A look inside reveals a simple elegance of design and sturdy construction.

The Small Computer Catalog for the rest of the real computer system story.

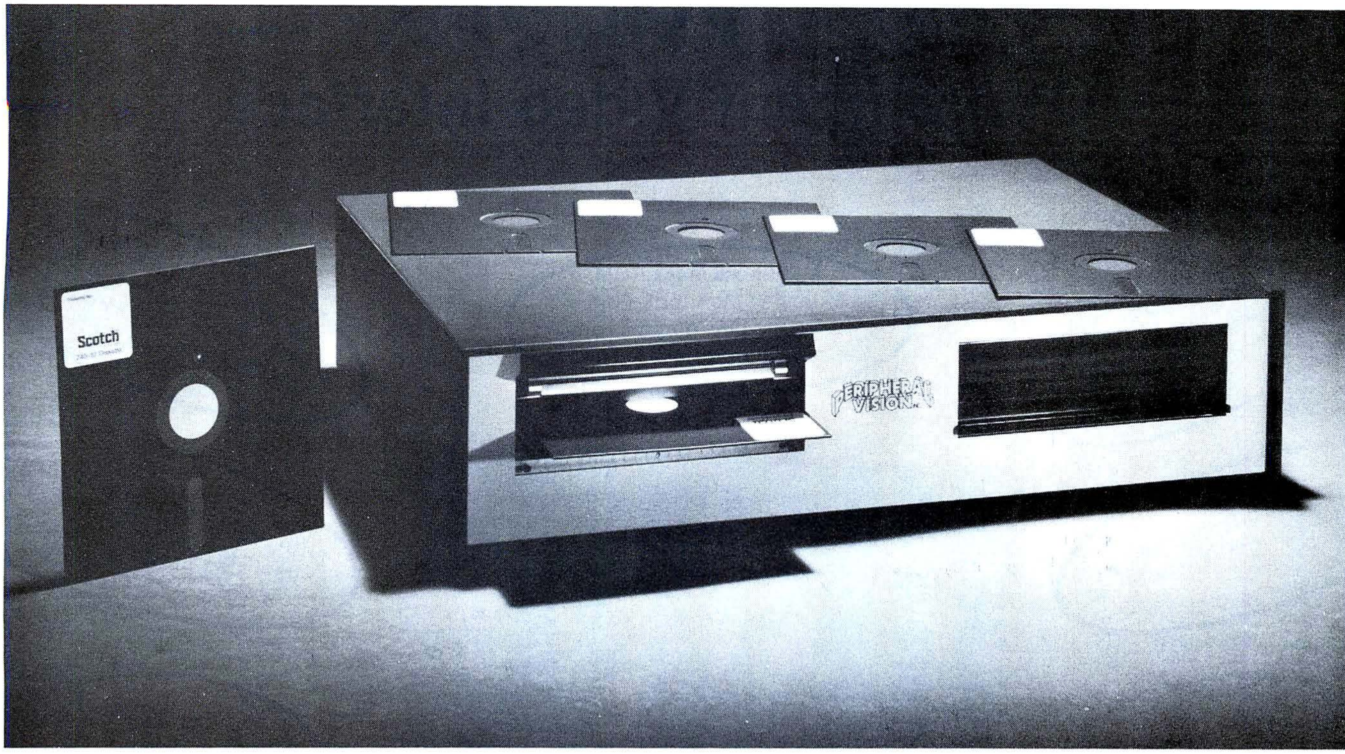
Visit your local computer store for a copy of our fully illustrated 22 page catalog. Or you may write or call us if more convenient. Please address Processor Technology, Box G, 6200 Hollis Street, Emeryville, CA 94608. (415) 652-8080.

Processor Technology Corporation

PROGRAM TO MAKE HEXAPOD WALK

```
         DIMENSION IBUF1(256),BUF(48),
      6US(3),ISW(6),IWAITS(6),TLIFT(6),TPLACE(6)
      6,XD(3)
         REAL L1,L2,L3,L4,L5
         INTEGER*4 ITIM,IT0
         COMMON /BLANK/BETA,ALAM,SPEED,
         SGNU,VELG(3),POSG(3),AMP,RANGE,
      6POLE,REFDTH(3),REFTH(3),T,SCRV(6),
      SCAIN(3),TH1UP,TH2UP
         COMMON /DATA/X(36),U(18),TR,PSILIM,
         IMINT(6),
      6THLIM,TH2LIM,L1,L2,L3,L4,L5,LEGNO,
      XS(6),TOLER
         COMMON /SINCOS/CP,SP,CT1,CT2,ST1,
         ST2,ATL5L1,
      6SQL1,SQL2,SQL5,RTL1L5
         COMMON /FAST/ID,U1(18),U2(18),
         SLOPE(18),DT(6),
      6TOLD(6),DELT,SCALU(18),SCALE(36),
      REFA(6,3),REFR(6,3)
         EQUIVALENCE (BUF(1),BETA),(BUF(2),
         ALAM),(BUF(3),SPEED),
      6(BUF(4),SGNU),(BUF(11),AMP),(BUF(12),
      RANGE),
      6(BUF(13),POLE),(BUF(20),T),(BUF(30),
      TH1UP),
      6(BUF(31),TH2UP)
         ASIN(X)=ATAN2(X,SQRT(1.-X**2))
         CALL ASSIGN (2,'LEG.DAT',0,'RDO')
         DEFINE FILE 2(1,256,U,I11)
         READ (2'1,ERR=120)IBUF1
         GO TO 125
120      PAUSE 'READ ERROR'
125      DECODE (512,50,IBUF1)BUF
50       FORMAT(8(6F10.4,4X))
         WRITE (5,60)BUF
         L1=BUF(32)
         L2=BUF(33)
         L3=BUF(34)
         L4=BUF(35)
         L5=BUF(36)
         TOLER=BUF(37)
         SQL1=L1**2
         SQL2=L2**2
         SQL5=L5**2
         RTL1L5=2.*L2*SQRT(SQL1+SQL5)
         ATL5L1=ATAN2(L5,L1)
         CALL LOCK
         CALL IPOKE("177546,"100)
         IF (IQSET(9).NE.0)STOP 'QUEUE
         ELEMENT ERROR'
         PAUSE 'CLOCK PERIOD IN TICKS-12
         FORMAT'
         READ (5,57)ID
         WRITE (5,57)ID
57       FORMAT (12)
         PAUSE 'SPEED CORRECTION FACTOR
         FOR LAST LOOP'
         READ (5,50)SPGAIN
         WRITE (5,60)SPGAIN
         DELT=ID.
         DELT=DELT760.*SPGAIN
C**********CLEAR ALL DAC CHANNELS**********
         DO 7 J=1,18
         U(J)=0.
7        CONTINUE
60       FORMAT (1X,6F10.5)
61       WRITE (5,10)
10       FORMAT(1X,7HLAMBDA=)
         READ (5,50)ALAM
         WRITE (5,60)ALAM
         WRITE (5,20)
20     FORMAT (1X,6HSPEED=)
         READ (5,50)SPEED
         WRITE (5,60)SPEED
         DO 30 J=1,3
         VELG(J)=BUF(4+J)
         POSG(J)=BUF(7+J)
         SCAIN(J)=BUF(26+J)
         SCAV(J)=BUF(20+J)
         SCAV(j+3)=BUF(23+J)
30       CONTINUE
         DO 32 J=1,3
         REFTH(J)=0.
         REFDTH(J)=0.
32       CONTINUE
         DO 33 K=1,6
         SCALE(K)=SCAV(K)
33       CONTINUE
         DO 34 K=7,36
         SCALE(K)=SCALE(K-6)
34       CONTINUE
         DO 35 K=1,3
         SCALU(K)=SCAIN(K)
35       CONTINUE
         DO 36 K=4,18
         SCALU(K)=SCALU(K-3)
36       CONTINUE
         CALL SSDAC(U,18,0,17,SCALU)
C ****************************************
C        RESET ALL LEGS TO THE STARTING
         POSITION
C ****************************************
D        PAUSE 'BEGIN INITIALISE EXERCISE'
         DO 46 LEGNO=1,6
45       CALL SSADC (XS,6,(LEGNO-1)*6,
         LEGNO*6-1,SCAV)
         CALL SERVO (US,IERR)
         CALL SSDAC (US,3,(LEGNO-1)*3,
         LEGNO*3-1,SCAIN)
         IF (IERR. NE. 1) GO TO 45
46       CONTINUE
         IF (SPEED(70,70,80
70       SGNU= -1.
         GO TO 90
80       SGNU=1.
C ****************************************
```

FLIP OVER OUR FLOPPY



Only $750 from Peripheral Vision.

Peripheral Vision is a brand-new company that's dedicated to selling reasonably priced peripherals for various manufacturers' CPU's.

We think you'll flip over our first product.

It's a full-size floppy disk for the Altair-Imsai plug-in compatible S-100 BUS. And it's available for as low as $750.

Here are the features:

- 1 interface card supports 4 drives
- Stores over 300,000 bytes per floppy
- Bootstrap EPROM included—no more toggling or paper tape
- Completely S-100 plug-in compatible
- Interface cabling included
- Drive is from Innovex (the originator of the floppy concept)—assembled and tested
- Interface card design is licensed from Dr. Kenneth Welles and the Digital Group
- Disk operating system with file management system included on floppy
- Cabinet and power supply optional

Prices:	Kit	Assm.
Interface card kit and assembled and tested drive	$750	$850
Power supply—+24V at 2A	45	65
Cabinet—Optima, blue	—	85

Now, a little more about our company.

Peripheral Vision may be brand-new, but we have some old-fashioned ideas about how to run our business.

We know there are serious incompatibilities among the different manufacturers' peripherals and CPU's. We want to get them together. And, we want to bring significant new products to market—products consisting of everything from adaptation instructions/kits for hardware and software to major new products.

It's a tall order, but we feel we're up to the task. Peripheral Vision has already obtained a license from The Digital Group to adapt versions of some of their products to the S-100 BUS. And we're working on getting more from other companies.

Most important to our customers, Peripheral Vision is committed to helping you get along with your computer. We'll do all we can to make it easy.

Write us now for all the information on our company, our philosophy and our exciting line of products. And be prepared to flip over all of it.

PERIPHERAL VISION INC.

P.O. Box 6267 / Denver, Colorado 80206 / (303) 733-1678

Send me the works, and I just might flip over it!

Name____________________

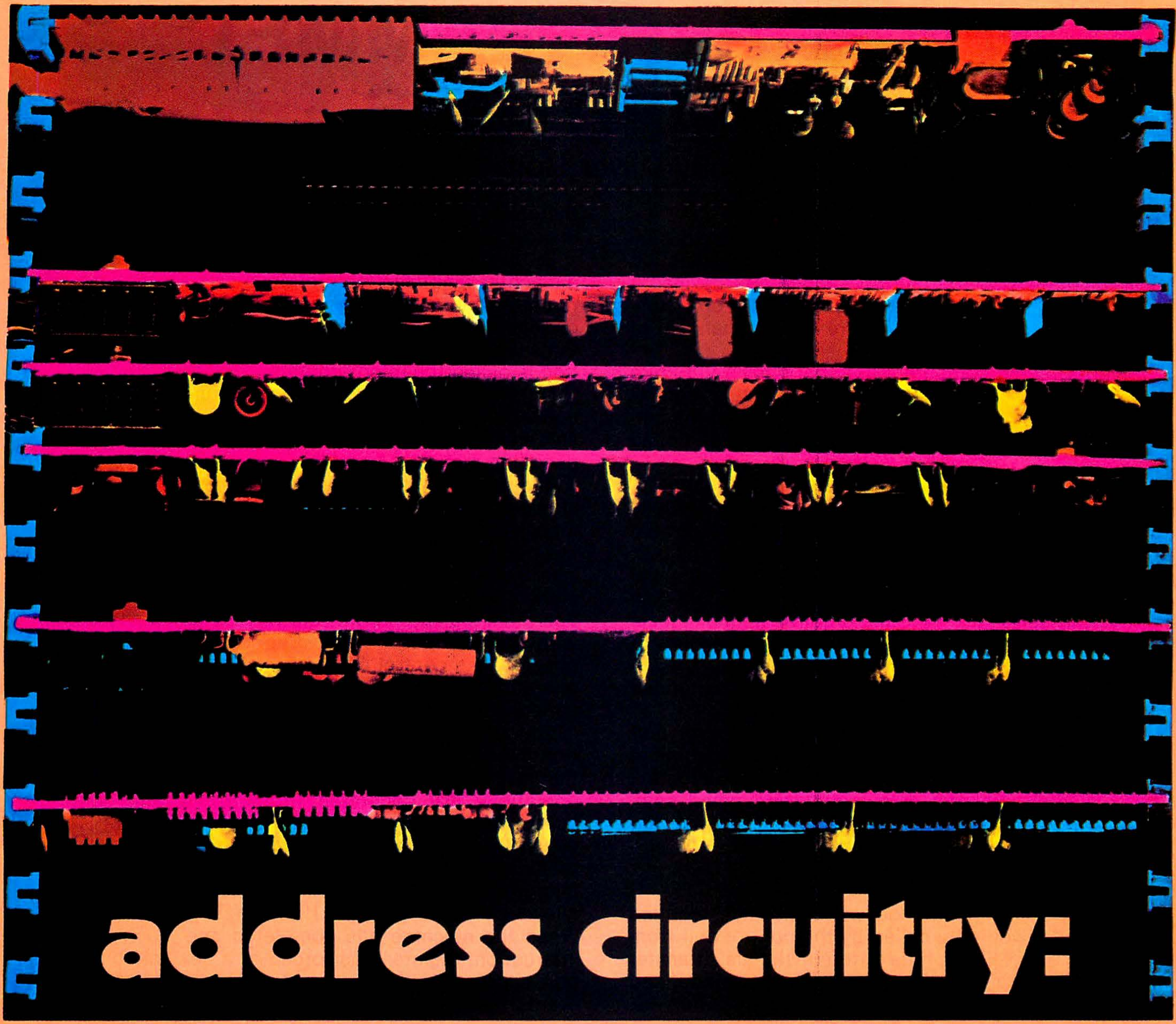
Address____________________

City/State/Zip____________________

```
C               CALCULATE THE LIMIT OF THE
                FORWARD STROKE AND MOVE LEG
C               1 TO THAT POSITION TO GET AN IDEA
                OF THE TRANSFER TIME
C ......................................................
D               PAUSE 'CALCULATE LIMIT OF
                FORWARD STROKE'
90              XD(1) = ALAM/2.
                XD(2) = L1 + L4
                XD(3) = L2 + L5
                CALL COORD(XD)
                PSILIM = REFTH(3)
                TH1LIM = REFTH(1)
                TH2LIM = REFTH(2)
D               WRITE (5,60)TH1LIM,TH2LIM,PSILIM
                CTH1L = COS(TH1LIM)
                STH1L = SIN(TH1LIM)
                CTH2L = COS(TH2LIM)
                STH2L = SIN(TH2LIM)
                STHSL = SIN(TH1LIM + TH2LIM)
C ......................................................
C
D               PAUSE 'TRANSFER TIME'
D               READ (5,50)TR
56              FORMAT (I1)
C
C ......................................................
C ......................................................
C               MOVE ALL LEGS TO POINTS JUST
                BEFORE TOUCHDOWN OF
C               LEG 1 IN THE LOCOMOTION CYCLE-
                LEGS TO BE LIFTED IN THE AIR
C               ARE ALL MOVED TO END OF TRANSFER
                PHASE POSITION
C ......................................................
3867            TOT = TR + ALAM/SPEED
                BETA = (TOT-TR)/TOT
                TPLACE(1) = 0.
                TPLACE(3) = BETA
                TPLACE(5) = 2. *BETA-1.
                TPLACE(2) = TPLACE(1) + 0.5
                TPLACE(4) = TPLACE(3) + 0.5
                TPLACE(6) = TPLACE(5) + 0.5
                DO 222 J = 1,6
                TLIST(J) = TPLACE(J) + BETA
222             CONTINUE
                DO 223 J = 1,6
                IF (TPLACE(J).LT.1.)GO TO 224
                TPLACE(J) = TPLACE(J)-1.
224             TPLACE(J) = TPLACE(J)*TOT
                IF (TLIST(J).LT.1.)GO TO 2225
                TLIST(J) = TLIFT(J)-1.
2225            TLIFT(J) = TLIFT(J)*TOT
223             CONTINUE
D               PAUSE 'TRANSFER TIME'
D               WRITE (5,60)TR
D               PAUSE 'LEG PLACEMENT TIMES'
D               WRITE (5,60)TPLACE
D               PAUSE 'LEG LIFTOFF TIMES'
D               WRITE (5,60)TLIFT
D               PAUSE 'BETA'
D               WRITE (5,60)BETA
D               PAUSE 'CONTINUE'
456             T = 0.
                DO 243 J = 1,3
                REFDTH(J) = 0.
243             CONTINUE
                DO 320 LEGNO = 2,6
                IWAITS(LEGNO) = 0
                IF (TPLACE(LEGNO).GT.TLIFT(LEGNO))
                GO TO 340
                ISW(LEGNO) = 2
                IWAITS(LEGNO) = 1
                GO TO 320
340             ISW(LEGNO) = 1
                TPLACE(LEGNO) = TPLACE(LEGNO)-TOT
320             CONTINUE
                REFTH(1) = TH1UP
                REFTH(2) = TH2UP
                REFTH(3) = PSILIM
                LEGNO = 1
106             CALL SSADC(XS,6,0,5,SCAV)
                CALL SERVO(US,IERR)
                CALL SSDAC(US,3,0,2,SCAIN)
                IF (IERR.NE.1)GO TO 106
                ISW(1) = 1
350             DO 360 LEGNO = 2,6
                IF (ISW(LEGNO).EQ.1)GO TO 355
                REFTH(1) = TH1UP
                REFTH(2) = TH2UP
                REFTH(3) = PSILIM
375             DO 12555 J = 1,3
                REFA(LEGNO,J) = REFTH(J)
                REFR(LEGNO,J) = 0.
12555           CONTINUE
3755            CALL SSADC(XS,6,(LEGNO-1)*6,
                LEGNO*6-1,SCAV)
                CALL SERVO (US,IERR)
                CALL SSDAC(US,3,(LEGNO-1)*3,
                LEGNO*3-1,SCAIN)
                IF (IERR.NE.1)GO TO 3755
360             CONTINUE
                GO TO 385
355             XD(1) = ALAM/2.-SPEED*(T-TPLACE
                (LEGNO))
                XD(2) = L1 + L4
                XD(3) = L2 + L5
                CALL COORD(XD)
                GO TO 375
385             T = 0.
                ISW(1) = 1
C ......................................................
C               INITIALISE ALL SWITCHES BEFORE
                COMMENCING LOCOMOTION CYCLE
C ......................................................
                DO 102 LEGNO = 1,6
                IMINT(LEGNO) = 0
102             CONTINUE
                CALL TRAJ(TOT)
D               PAUSE 'BEGIN LOCOMOTION CYCLE'
                CALL GTIM(IT0)
                CALL CVTTIM(IT0,IHR0,IMIN0,ISEC0,
                ITIC0)
C ......................................................
C               START OF LOCOMOTION CYCLE AND
                CONTROL LOOP
C ......................................................
                CALL FILTER(ID)
225             CALL SSADC(X,36,0,35,SCALE)
                CALL GTIM(ITIM)
                CALL CVTTIM(ITIM,IHRS,IMIN,ISEC,ITIC)
                DEL = ITIC-ITIC0
                T = 60*(IMIN-IMIN0) + ISEC-ISEC0
                T = T + DEL/60.
                DO 210 LEGNO = 1,6
                IF (ISW(LEGNO).EQ.1)GO TO 1000
                IF (ISW(LEGNO).EQ.2)GO TO 2000
                IF (ISW(LEGNO).EQ.0)GO TO 3000
210             CONTINUE
                GO TO 225
C ......................................................
C               THE LEG IS ON THE GROUND-
                CALCULATE THE REFERENCE
C               TRAJECTORY AND THE DESIRED
                INPUTS AND RETURN
C ......................................................
1000            DO 1240 J = 1,6
                XS(J) = X((LEGNO-1)*6 + J)
1240            CONTINUE
                CALL FASREF(TPLACE,TOT)
                DO 12556 J = 1,3
                REFA(LEGNO,J) = REFTH(J)
                REFR(LEGNO,J) = REFDTH(J)
12556           CONTINUE
                CALL SERVO(US,IERR)
                IF (T.LT.TLIFT(LEGNO)) GO TO 2110
                ISW(LEGNO) = 2
                IMINT(LEGNO) = 0
                TLIFT(LEGNO) = T + TOT
                TPLACE(LEGNO) = T + TR
2110            DO 2120 J = 1,3
                U((LEGNO-1)*3 + J) = US(J)
2120            CONTINUE
                GO TO 210
C ......................................................
C               THE LEG IS IN THE TRANSFER PHASE-
                CALCULATE THE
C               DESIRED INPUTS AND RETURN-SET A
                SWITCH IF TRANSFER PHASE
C               IS OVER TOO SOON AND LEG MUST
                WAIT IN THE AIR
C ......................................................
2000            IF (IWAITS(LEGNO).EQ.1)GO TO 1001
                DO 2240 J = 1,6
                XS(J) = X((LEGNO-1)*6 + J)
2240            CONTINUE
                REFDTH(1) = 0.
                REFDTH(2) = 0.
                REFDTH(3) = 0.
                REFTH(1) = TH1UP
                REFTH(2) = TH2UP
                REFTH(3) = PSILIM
                DO 12557 J = 1,3
                REFA(LEGNO,J) = REFTH(J)
                REFR(LEGNO,J) = 0.
12557           CONTINUE
                CALL SERVO (US,IERR)
                IMINT(LEGNO) = IMINT(LEGNO) + 1
                IF (IERR.EQ.1)GO TO 1001
3100            DO 3120 J = 1,3
                U((LEGNO-1)*3 + J) = US(J)
3120            CONTINUE
                GO TO 210
1001            IF (T.GT.TPLACE(LEGNO))GO TO 1011
                IWAITS(LEGNO) = 1
                GO TO 210
1011            ISW(LEGNO) = 0
                IWAITS(LEGNO) = 0
                GO TO 3100
C ......................................................
C               BEGIN TO SET THE LEG DOWN AND
                PREPARE TO
C               COMMENCE THE DUTY CYCLE
C ......................................................
3000            DO 4240 J = 1,6
                XS(J) = ((LEGNO-1)*6 + J)
4240            CONTINUE
                REFTH(1) = TH1LIM
                REFTH(2) = TH2LIM
                REFTH(3) = PSILIM
                DO 12558 J = 1,3
                REFR(LEGNO,J) = 0.
                REFA(LEGNO,J) = REFTH(J)
12558           CONTINUE
                CALL SERVO(US,IERR)
                DO 5240 J = 1,3
                U((LEGNO-1)*3 + J) = US(J)
5240            CONTINUE
                ISW(LEGNO) = 1
                IF (LEGNO.NE.1)GO TO 210
D               WRITE (5,60)T
                GO TO 225
                STOP
                END
                SUBROUTINE SERVO(US,IERR)
                REAL L1,L2,L3,L4,L5
                DIMENSION BUF(48),US(3)
                COMMON /BLANK/BETA,ALAM,SPEED,
                SGNU,VELG(3),POSG(3),AMP,RANGE,
               6POLE,REFDTH(3),REFTH(3),T,SCAV(6),
                SCAIN(3),TH1UP,TH2UP
                COMMON /DATA/X(36),U(18),TR,PSILIM,
                IMINT(6),
               6TH1LIM,TH2LIM,L1,L2,L3,L4,L5,LEGNO,
                XS(6),TOLER
                COMMON /SINCOS/CP,SP,CT1,CT2,ST1,
                ST2,ATL5L1,
               6SQL1,SQL2,SQL5,RTL1L5
                COMMON /FAST/ID,U1(18),U2(18),
                SLOPE(18),DT(6).
```

HEXAPOD PROGRAM (Cont.)

```
6TOLD(6),DELT,SCALU(18),SCALE(36),
REFA(6,3),REFR(6,3)
   EQUIVALENCE (BUF(1),BETA),(BUF(2),
   ALAM),(BUF(3),SPEED),
6(BUF(4),SGNU),(BUF(11),AMP),(BUF(12),
RANGE),
6(BUF(13),POLE),(BUF(20),T),(BUF(30),
TH1UP),
6(BUF(31),TH2UP)
10       CONTINUE
         DO 20 I = 1,3
         IF (US(I).GT.9.5)US(I) = 9.5
         IF (US(I).LT.-9.5)US(I) = -9.5
20       CONTINUE
         IF (ERR.GT.TOLER)RETURN
         IERR = 1
         US(1) = 0.
         US(2) = 0.
         US(3) = 0.
         DO 40 J = 1,3
40       CONTINUE
         RETURN
         END
         SUBROUTINE REF(TPLACE)
         REAL L1,L2,L3,L4,L5
         DIMENSION BUF(48),US(3),TPLACE(6)
         COMMON /BLANK/BETA,ALAM,SPEED,
         SGNU,VELG(3),POSG(3),AMP,RANGE,
       6POLE,REFDTH(3),REFTH(3),T,SCAV(6),
       SCAIN(3),TH1UP,TH2UP
         COMMON /DATA/X(36),U(18),TR,PSILIM,
         IMINT(6),
       6TH1LIM,TH2LIM,L1,L2,L3,L4,L5,LEGNO,
       XS(6),TOLER
         COMMON /SINCOS/CP,SP,CT1,CT2,ST1,
         ST2,ATL5L1,
       6SQL1,SQL2,SQL5,RTL1L5
         COMMON /FAST/ID,U1(18),U2(18),
         SLOPE(18),DT(6),
       6TOLD(6),DELT,SCALU(18),SCALE(36),
       REFA(6,3),REFR(6,3)
         EQUIVALENCE (BUF(1),BETA),(BUF(2),
         ALAM),(BUF(3),SPEED),
       6(BUF(4),SGNU),(BUF(11),AMP),(BUF(12),
       RANGE),
       6(BUF(13),POLE),(BUF(20),T),(BUF(30),
       TH1UP),
       6(BUF(31),TH2UP)
         DX = -SPEED
         DY = 0.
         DZ = 0.
         Y = L1 + L4
         Z = L2 + L5
         X1 = ALAM/2.-SPEED*(T-TPLACE(LEGNO))
         US(1) = X1
         US(2) = Y
         US(3) = Z
         CALL COORD(US)
         TH = REFTH(1) + REFTH(2)
         STH = SIN(TH)
         CTH = COS(TH)
         CT1 = COS(REFTH(1))
         ST1 = SIN(REFTH(1))
         TN1 = L1*CT1 + L2*STH + L5*ST1
         D1 = L4 + TN1
         D2 = L2*(L1*CT2-L5*ST2)
         A11 = SP/D1
         A21 = (L2*STH*CP/D2 + L3*SP*STH/
         D1/D2)
         A31 = CP*TN1/D2 + L3*SP*TN1/D1/D2
         A12 = CP/D1
         A22 = L2*SP*STH/D2 + L2*L3*CP*STH/
         D1/D2
         A32 = SP*TN1/D2-L3*CP*TN1/D1/D2
         A13 = 0.
         A23 = -L2*CTH/D2
         A33 = (-L1*ST1 + L2*CTH + L5*CT1)/D2
         REFDTH(1) = A21*DX + A22*DY + A23*DZ
         REFDTH(2) = A31*DX + A32*DY + A33*DZ
         REFDTH(3) = -(A11*DX + A12*DY + A13*DZ
         RETURN
         END
         SUBROUTINE COORD(XD)
         REAL L1,L2,L3,L4,L5
         DIMENSION BUF(48),US(3),XD(3)
         COMMON /BLANK/BETA,ALAM,SPEED,
         SGNU,VELG(3),POSG(3),AMP,RANGE,
       6POLE,REFDTH(3),REFTH(3),T,SCAV(6),
       SCAIN(3),TH1UP,TH2UP
         COMMON /DATA/X(36),U(18),TR,PSILIM,
         IMINT(6),
       6TH1LIM,TH2LIM,L1,L2,L3,L4,L5,LEGNO,
       XS(6),TOLER
         COMMON /SINCOS/CP,SP,CT1,CT2,ST1,
         ST2,ATL5L1,
       6SQL1,SQL2,SQL5,RTL1L5
         COMMON /FAST/ID,U1(18),U2(18),
         SLOPE(18),DT(6),
       6TOLD(6),DELT,SCALU(18),SCALE(36),
       REFA(6,3),REFR(6,3)
         EQUIVALENCE (BUF(1),BETA),(BUF(2),
         ALAM),(BUF(3),SPEED),
       6(BUF(4),SGNU),(BUF(11),AMP),(BUF(12),
       RANGE),
       6(BUF(13),POLE),(BUF(20),T),(BUF(30),
       TH1UP),
       6(BUF(31),TH2UP)
         ASIN(X) = ATAN2(X,SQRT(1.-X**2))
         X1 = XD(1)
         Y = XD(2)
         Z = XD(3)
         PSI = ASIN(L3/SQRT(Y**2 + X1**2)) +
         ATAN2(X1,Y)
         CP = SIN(PSI)
         SP = COS(PSI)
         T1 = ((Y-L4*SP + L3*CP)/SP)**2 + Z**2-
         SQL1-SQL2-SQL5
         TH2 = ASIN(T1/RTL1L5)-ATL5L1
         CT2 = COS(TH2)
         ST2 = SIN(TH2)
         T1 = L5 + L2*CT2
         T2 = L1 + L2*ST2
         TH1 = ASIN(Z/(SQRT(T1**2 + T2**2))) +
         ATAN2(T1,T2)
         REFTH(1) = TH2
         REFTH(2) = TH1
         REFTH(3) = PSI
         RETURN
         END
         SUBROUTINE FILTER(ID)
         INTEGER*2 AREA(4)
         REAL L1,L2,L3,L4,L5
         EXTERNAL FILTER
         DIMENSION BUF(48)
         COMMON /BLANK/BETA,ALAM,SPEED,
         SGNU,VELG(3),POSG(3),AMP,RANGE,
       6POLE,REFDTH(3),REFTH(3),T,SCAV(6),
       SCAIN(3),TH1UP,TH2UP
         COMMON /DATA/X(36),U(18),TR,PSILIM,
         IMINT(6),
       6TH1LIM,TH2LIM,L1,L2,L3,L4,L5,LEGNO,
       XS(6),TOLER
         COMMON /SINCOS/CP,SP,CT1,CT2,ST1,
         ST2,ATL5L1,
       6SQL1,SQL2,SQL5,RTL1L5
         COMMON /FAST/ID,U1(18),U2(18),
         SLOPE(18),DT(6),
       6TOLD(6),DELT,SCALU(18),SCALE(36),
       REFA(6,3),REFR(6,3)
         EQUIVALENCE (BUF(1),BETA),(BUF(2),
         ALAM),(BUF(3),SPEED),
       6(BUF(4),SGNU),(BUF(11),AMP),(BUF(12),
       RANGE),
       6(BUF(13),POLE),(BUF(20),T),(BUF(30),
       TH1UP),
       6(BUF(31),TH2UP)
         DO 10 J = 1,6
         DO 20 K = 1,3
         REFA(J,K) = REFA(J,K) + DELT*REFR(J,K)
20       CONTINUE
10       CONTINUE
         CALL SSAD(X,36,0,35,SCALE)
         DO 30 J = 1,6
         DO 40 I = 1,3
         M = (J-1)*3 + I
         N = (J-1)*6 + I
         U(M) = POSG(I)*(REFA(J,I)-X(N)
       6 + VELG(I)*(REFR(J,I)-X(N + 3))
40       CONTINUE
30       CONTINUE
         CALL SSDAC(U,18,0,17,SCALU)
         CALL ITIMER(0,0,0,ID,AREA,ID,FILTER)
         RETURN
         END
         SUBROUTINE TRAJ(TOT)
         REAL L1,L2,L3,L4,L5
         DIMENSION BUF(48),US(3),TPLACE(6)
         COMMON /BLANK/BETA,ALAM,SPEED,
         SGNU,VELG(3),POSG(3),AMP,RANGE,
       6POLE,REFDTH(3),REFTH(3),T,SCAV(6),
       SCAIN(3),TH1UP,TH2UP
         COMMON /DATA/X(36),U(18),TR,PSILIM,
         IMINT(6),
       6TH1LIM,TH2LIM,L1,L2,L3,L4,L5,LEGNO,
       XS(6),TOLER
         COMMON /SINCOS/CP,SP,CT1,CT2,ST1,
         ST2,ATL5L1,
       6SQL1,SQL2,SQL5,RTL1L5
         COMMON /FAST/ID,U1(18),U2(18),
         SLOPE(18),DT(6),
       6TOLD(6),DELT,SCALU(18),SCALE(36),
       REFA(6,3),REFR(6,3)
         EQUIVALENCE (BUF(1),BETA),(BUF(2),
         ALAM),(BUF(3),SPEED),
       6(BUF(4),SGNU),(BUF(11),AMP),(BUF(12),
       RANGE),
       6(BUF(13),POLE),(BUF(20),T),(BUF(30),
       TH1UP),
       6(BUF(31),TH2UP)
         LEGNO = 1
         T = 0.
         TPLACE(1) = 0.
         TON = TOT-TR
         TINC = TON/500.
         DO 100 I = 1,500
         CALL REF(TPLACE)
         DO 200 J = 11,3
         RATE(J,I) = REFDTH(J)
         ANGLE(J,I) = REFTH(J)
200      CONTINUE
         T = T + TINC
100      CONTINUE
60       FORMAT (1X,F12.4,3X,F12,4)
300      CONTINUE
         T = 0.
         RETURN
         END
         SUBROUTINE FASRED(TPLACE,TOT)
         REAL L1,L2,L3,L4,L5
         DIMENSION BUF(48),US(3),TPLACE(6)
         COMMON /BLANK/BETA,ALAM,SPEED,
         SGNU,VELG(3),POSG(3),AMP,RANGE,
       6POLE,REFDTH(3),REFTH(3),T,SCAV(6),
       SCAIN(3),TH1UP,TH2UP
         COMMON /DATA/X(36),U(18),TR,PSILIM,
         IMINT(6),
       6TH1LIM,TH2LIM,L1,L2,L3,L4,L5,LEGNO,
       XS(6),TOLER
         COMMON /SINCOS/CP,SP,CT1,CT2,ST1,
         ST2,ATL5L1,
       6SQL1,SQL2,SQL5,RTL1L5
         COMMON /FAST/ID,U1(18),U2(18),
         SLOPE(18),DT(6),
       6TOLD(6),DELT,SCALU(18),SCALE(36),
       REFA(6,3),REFR(6,3)
         EQUIVALENCE (BUF(1),BETA),(BUF(2),
         ALAM),(BUF(3),SPEED),
       6(BUF(4),SGNU),(BUF(11),AMP),(BUF(12),
       RANGE),
       6(BUF(13),POLE),(BUF(20),T),(BUF(30),
       TH1UP),
       6(BUF(31),TH2UP)
         TON = T-TPLACE(LEGNO)
         TINC = (TOT-TR)/500.
         IAD = TON/TINC
         IF (IAD.GT.500)IAD = 500
         DELTA = TON-TINC*IAD
         DO 100 J = ,3
         REFTH(J) = ANGLE(J,IAD) + DELTA*
         (ANGLE(J,IAD + 1)-
       6ANGLE(J,IAD))/TINC
         REFDTH(J) = RATE(J,IAD) + DELTA*
         (RATE(J,IAD + 1)
       6-RATE(J,IAD))/TINC
100      CONTINUE
         RETURN
         END
```



Altair Computer Centers offer you direct access to the complete line of Altair microcomputer products. For demonstrations, information or service, visit the experts at your local Altair Computer Center today. They're located at these addresses:

ALTAIR COMPUTER CENTER
4941 East 29th St.
TUCSON, AZ 85711
(602)-748-7363

COMPUTER KITS (S.F. area)
1044 University Ave.
BERKELEY, CA 94710
(415)-845-5300

THE COMPUTER STORE
(Arrowhead Computer Co.)
820 Broadway
SANTA MONICA, CA 90401
(213)-451-0713

THE COMPUTER STORE, INC.
(Hartford area)
63 South Main Street
WINDSOR LOCKS, CT 06096
(203)-627-0188

GATEWAY ELECTRONICS, INC.
OF COLORADO
2839 W. 44th Ave.
DENVER, CO 80211
(303)-458-5444

THE COMPUTER SYSTEMCENTER
3330 Piedmont Road
ATLANTA, GA 30305
(404)-231-1691

CHICAGO COMPUTER STORE
517 Talcott Rd.
PARK RIDGE, IL 60068
(312)-823-2388

THE COMPUTER STORE, INC.
120 Cambridge St.
BURLINGTON, MA 01803
(617)-272-8770

THE COMPUTER STORE
OF ANN ARBOR
310 East Washington Street
ANN ARBOR, MI 48104
(313)-995-7616

COMPUTER STORE OF DETROIT
505-507 West 11 Mile St.
MADISON HEIGHTS, MI 48071
(313)-545-2225

THE COMPUTER ROOM
3938 Beau D'Rue Drive
EAGAN, MN 55122
(612)-452-2567

GATEWAY ELECTRONICS, INC.
8123-25 Page Blvd.
ST. LOUIS, MO 63130
(314)-427-6116

ALTAIR COMPUTER CENTER
5252 North Dixie Drive
DAYTON, OH 45414
(513)-274-1149

ALTAIR COMPUTER CENTER
110 The Annex
5345 East Forty First St.
TULSA, OK 74135
(918)-664-4564

ALTAIR COMPUTER CENTER
8105 SW Nimbus Ave.
BEAVERTON, OR 97005
(503)-644-2314

ALTAIR COMPUTER CENTER
611 N. 27th St. Suite 9
LINCOLN, NB 68503
(402)-474-2800

COMPUTER STORES
OF CAROLINA, INC.
1808 E. Independence Blvd.
CHARLOTTE, N.C. 28205
(704)-334-0242

COMPUTER SHACK
3120 San Mateo N.E.
ALBUQUERQUE, NM 87110
(505)-883-8282, 883-8283

THE COMPUTER STORE
269 Obsorne Rd.
ALBANY, NY 12211
(518)-459-6140

THE COMPUTER STORE
OF NEW YORK
55 West 39th St.
NEW YORK, NY 10018
(212)-221-1404

ALTAIR COMPUTER CENTER
3208 Beltline Road
Suite 206
DALLAS, TX 75234
(214)-241-4088 Metro-263-7638

ALTAIR COMPUTER CENTER
5750 Bintliff Drive
HOUSTON, TX 77036
(713)-780-8981

COMPUTERS-TO-GO
4503 West Broad St.
RICHMOND, VA 23230
(804)-335-5773

MICROSYSTEMS (Washington, D.C.)
6605A Backlick Rd.
SPRINGFIELD, VA 22150
(703)-569-1110

THE COMPUTER STORE
Suite 5
Municipal Parking Building
CHARLESTON, W.VA. 25301
(304)-345-1360

mits

MICROPROGRAMMED COMPUTERS

by Oliver Holt

INTRODUCTION

Microprogramming is a technique originated in 1950 by Dr. Wilkes. He noted that the most complex section of a computer was the control section. He devised a philosophy of designing the control circuits of a computer which were general in nature and independent of the instruction set.

In conventional computers like that shown in Figure 1, the control unit generates all necessary control signals. These control signals are a product of the current instruction being executed and a set of timing pulses.

Each regular instruction requires a set sequence of steps in order to reach the desired outcome. Each of these steps occurs at a different point in time. Examples of these steps are: *enable* data flow on the bus, storing data in temporary registers, manipulating the data, and transferring the results back to the bus. The control unit generates all of the required gating signals at the required point in time. The control unit consists of a set of complex decoders and timing circuits. The circuits generate gating signals that are dependent on the current instruction.

In a microprogrammed computer, the control unit receives a predetermined set of control signals from the control memory and distributes these signals. Figure 2 shows a block diagram of a microprogrammed computer. Stated simply microprogramming is just the orderly generation of control signals.

WILKES MODEL

Dr. Wilkes' design method was that each required control signal would be called by the control unit from the control store. Each of the different signals, "transfer data", "store data", "manipulate data", etc. are defined as micro-operations. Each machine instruction is, therefore, made up of a set of micro-operations called microinstructions.

By executing a set of predescribed microinstructions, a machine language instruction is performed. Each different machine language instruction has a different set of microinstructions. The complete set of microinstructions used to perform a particular machine level instruction is called the microprogram.

Dr. Wilkes described an architecture on which his concepts could be demonstrated. Figure 3 shows such an architecture. The design centers around the decoding matrices A and B.

The decoding device maps the timing signals onto a single wire that passes through matrices A and B. The mapping decision depends on the information stored in the holding register (Reg I). Depending on the connection made by that wire in matrix A, a set of control signals is generated. The control signals or micro-operation signals control the various gates associated with the computer logic. The outputs of matrix B generate the control mechanism for selecting the next operation to be performed. In simple terms, matrix B generates the next microinstruction address.

The scheme of operation requires that the information in register I select a desired microinstruction and the next microinstruction address. The separate micro-operations are generated in matrix A and sent to associated control logic. The next micro-address is generated in matrix B and is stored in register II. When a predetermined length of time has passed, the next micro-instruction address that is stored in register II is allowed to pass register I and the cycle starts over. When the machine has completed one machine level instruction, register II is forced to a new microinstruction address ($f_{(g)}$) that now starts a new sequence of events that cause the next instruction to be executed.

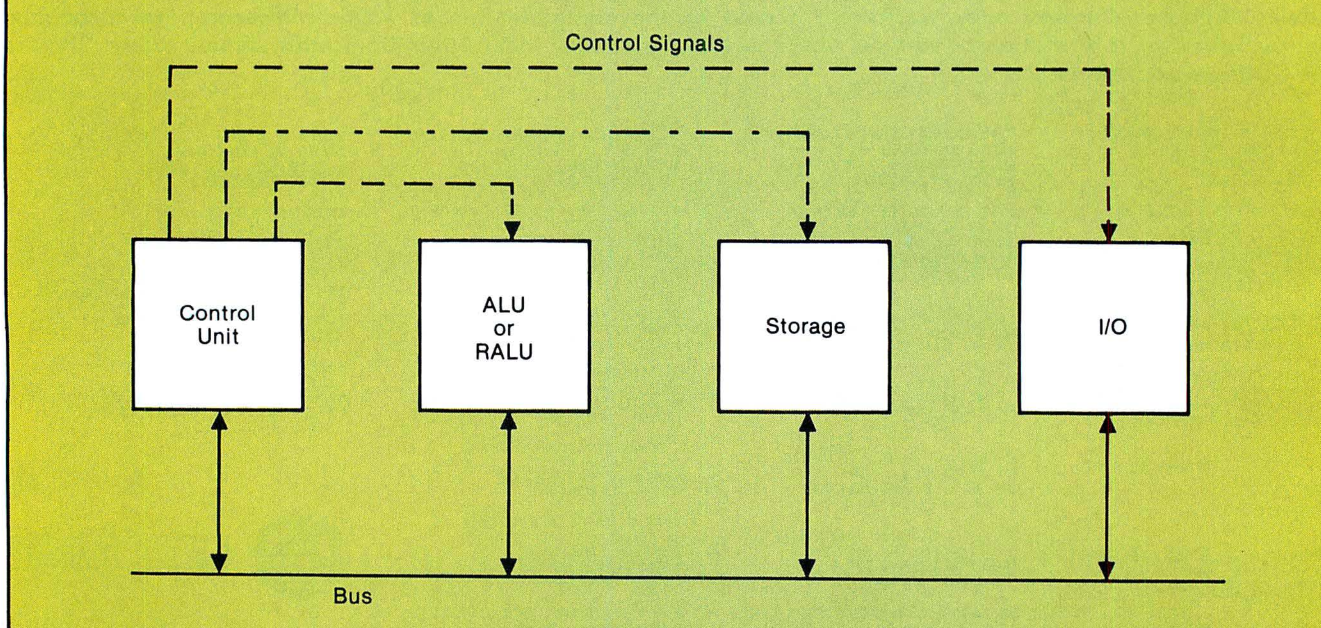


Figure 1. Conventional Computer Design

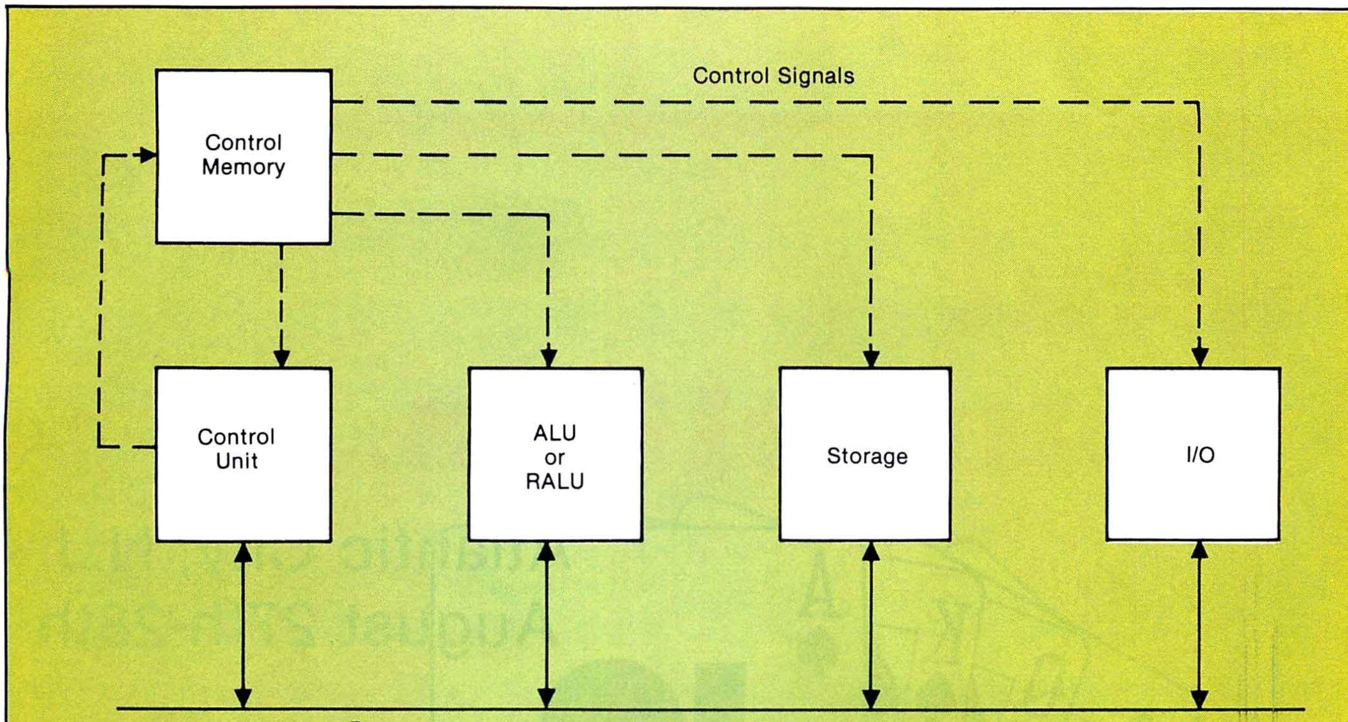


Figure 2. Microprogrammed Computer Design

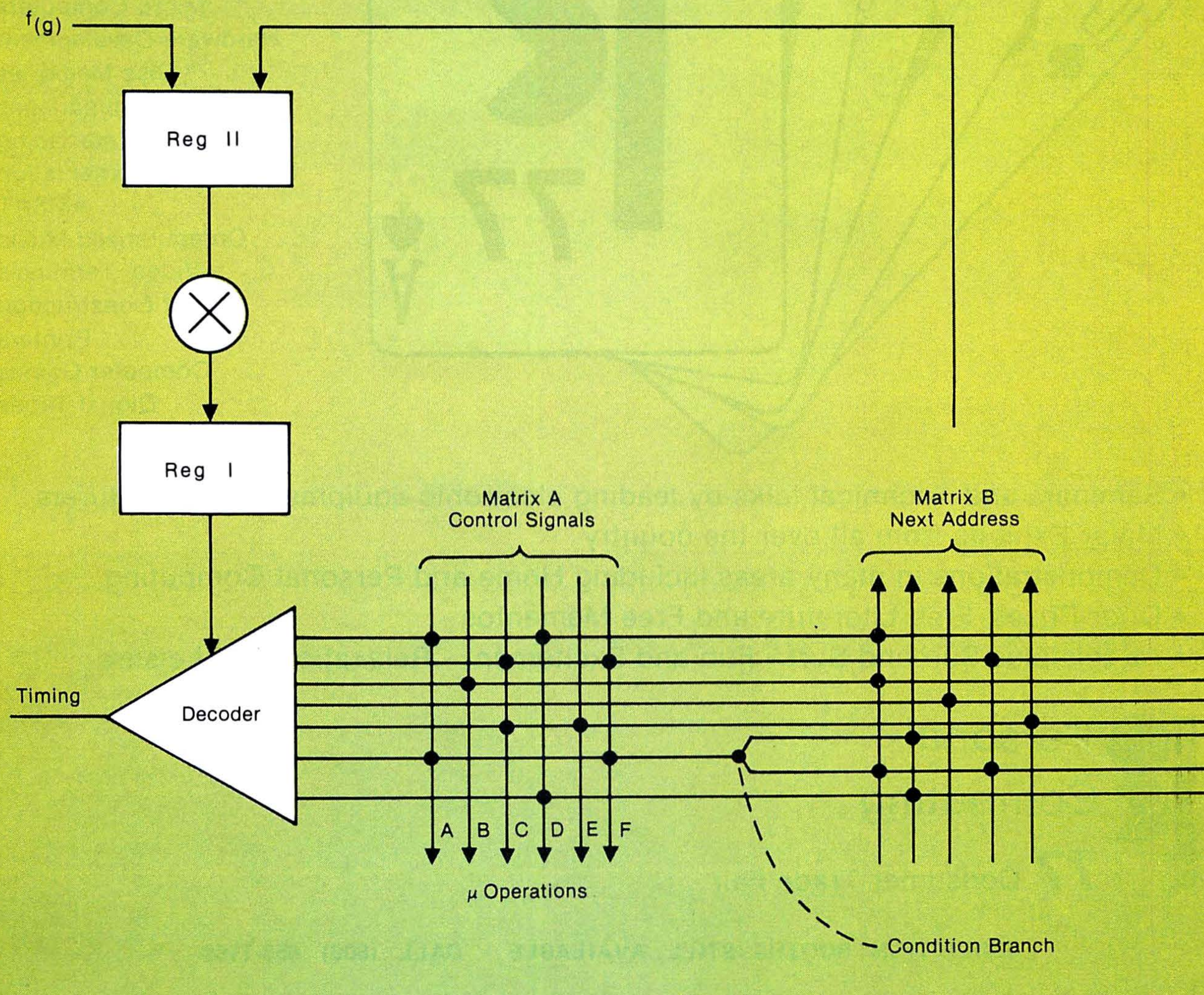


Figure 3. Wilkes Model

Your microcomputer is only as good as its memory

Your microcomputer is... in a manner of speaking... capable of thinking. The amount of information you can store, combined with the access speed, determines the bottom line capability of your microcomputer.

The Midwest Scientific Instruments' FD-8 Floppy Disk Memory System will enable you to get the most out of your microcomputer...6800 or 8080. We have the most complete 6800 disk operating system available today, which interfaces to any microcomputer via a single PIA chip.

When used with the MSI FDOS Operating System...included with purchase...the FD-8 gives your microcomputer a level of performance which can only be matched by larger computers.

You can have program save and load with named, variable length, password protected files at three levels: object code files, source code files, and BASIC files.

It has disk routines which can be used easily by low level assembler language programs as well as high level BASIC programs.

The coresident assembler/editor saves and loads source files from disk, assembles and stores object code on disk, and creates assembly listings on a high speed printer.

You get a full ANSI standard BASIC interpreter* with program load and save, from disk as well as tape, with both random and sequential disk data files. BASIC also has multi-I/O port capability under software control.

And all you need do to access any of these functions is type the appropriate commands on your terminal.

The FD-8 is complete, including all power supplies, cabinet, cables, software, manuals, and documentation.

You can order the FD-8 as a kit for $1,150.00, or wired and tested for $1,395.00.

Visit one of our dealers for a demonstration, or send for our free Catalog of MSI products.

American Microprocessors
Equipment & Supply Corp.
Chicagoland Airport, P.O. Box 515
Prairie View, Illinois 60069
(312) 634-0076

Microcomputer Systems, Inc.
144 South Dale Mabry Avenue
Tampa, Florida 33609
(813) 879-4301

Micro Store
634 South Central Expressway
Richardson, Texas 75080
(214) 231-1096

Vanguard Systems Corporation
6812 San Pedro
San Antonio, Texas 78216
(512) 828-0553

A-Vid Electronics Company
1655 East 28th Street
Long Beach, California 90806
(213) 426-5526

Electronics for Yachting
1525 South East 16th Street
Ft. Lauderdale, Florida 33316
(305) 525-3478
TWX 510-955-9484

High Technology
1020 West Wilshire Blvd.
Oklahoma City, Oklahoma 73116
(405) 842-2021

Computer Workshop
174 Ifield Road
London England
SW10 9AG
01-373-8571

Midwest Scientific Instruments

220 West Cedar • Olathe, Kansas 66061 • 913/764-3273
TWX 910 749 6403 (MSI OLAT)

☐ Before I forget...send me your catalog

Name ______________________

Address ______________________

City ______________________

State ______________ Zip ________

*MSI BASIC is an additional $65.00

MSI is a dealer for Southwest Technical Products • Mastercharge & BankAmericard Orders accepted

220 West Cedar • Olathe, Kansas 66061 • 913/764-3273 • TWX 910 749 6403 (MSI OLAT)

Figure 4. N Word by M Bit Microprogram Memory

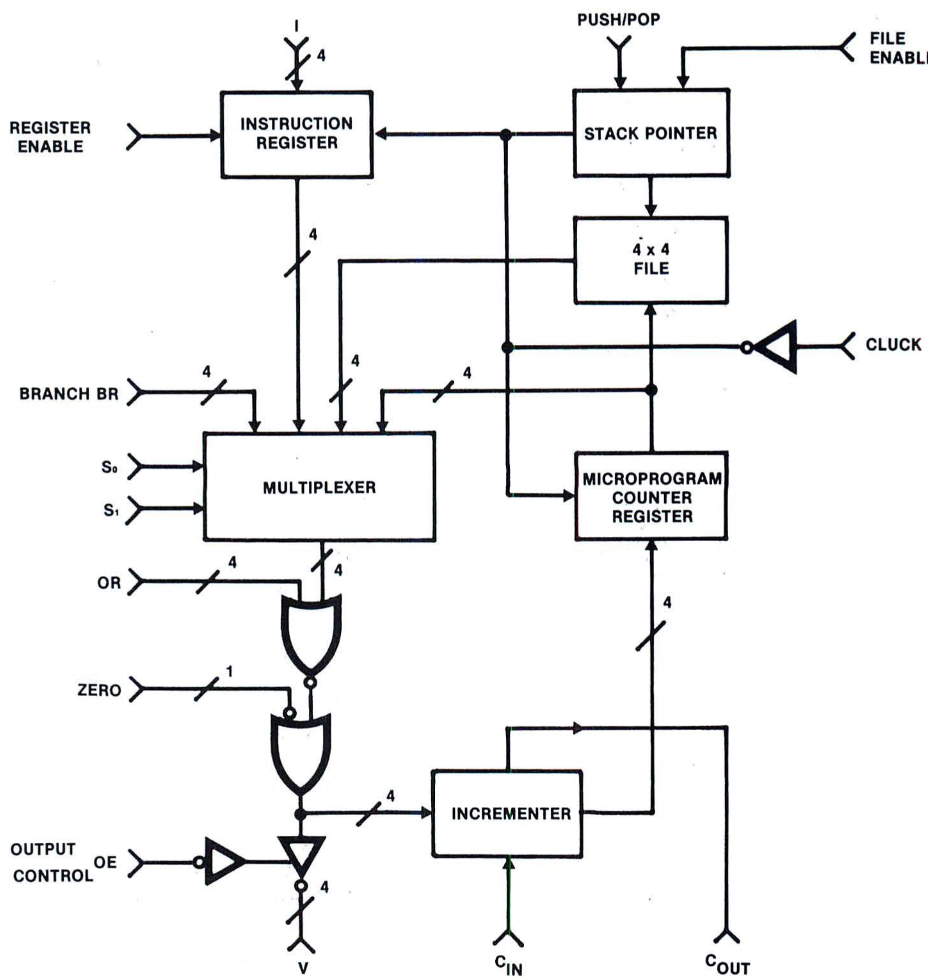


Figure 5. Block Diagram of a 2909 Microprogram Sequencer

CONDITIONAL OPERATIONS

Also shown in Figure 3 is a method of performing conditional operations within matrix B. As explained above, matrix B generates the next microinstruction address. By allowing multiple paths within matrix B and using certain status information to select the desired path, conditional branches like *jump on carry set, jump on negative result* and *jump on zero result* can be implemented. These conditional branches are also needed to implement the shift, and to add and test operations required in a machine level multiply or divide instructions.

APPLYING WILKES PHILOSOPHY USING TODAY'S LSI BUILDING BLOCKS

Now you are probably saying to yourself that the matrices can easily be replaced by some type of memory device and that the registers and decoders are nothing more than flip-flops and logic gates. The memory can be replaced by ROM or PROM and would be called a control store. Sometimes RAM is used and that would be called writable control store. The flip-flops and logic gates are used to build the decoder and the next address selection. The next address selection logic is called the microprogram sequencer. This sequencer can be built from a set of gates and flip-flops or can be built using one of the new microprogram controller chips. These new chips allow more control over what the next microinstruction will be than was possible with Wilkes' design.

The control store is usually organized into separate fields. Figure 4 shows an example of the organization of a microprogram memory. This example shows a microprogram in a microprogram memory with 8 different fields of different widths. These different fields control such things as the next microaddress, internal register address, address control, carry control, ALU control, bus control and microprogram sequencer control.

There are about 8 to 10 microprogram sequencers available today from manufacturers such as AMD, MMI, Signetics, Intel, Fairchild, and TI. These devices have many fascinating possibilities for different types of computer design.

Figure 5 shows a block diagram of the AM 2909 microprogram sequencer. This device allows conditional branching, direct address input, microprogram subroutine calls to 4 levels and an internal incrementer and microaddress register.

Figure 6 shows the 57110 microprogram controller. This device allows conditional branching, has subroutine storage to one level, has a microaddress incrementer/decrementer and allows microprogramming looping with an internal loop counter.

To work with these devices we have bit slice microprocessors. These devices have internal registers, shifters and arithmetic logic units. These devices can be expanded in either 2 or 4-bit increments depending on which device you choose. Figure 7 shows a typical example of a bit slice device.

Figure 7 is a 6701 4-bit slice. It has a 16 word multiport internal register, an arithmetic logic unit and a set of shifters. This device can perform arithmetic logic operations on two different registers, or one register and external data, and store the result back into an internal register or output the result to the bus, all in one microoperation. A set of 8 control signals specify the operations to be performed within the 6701 and two 4-bit words are required to specify the registers upon which to be operated.

BUILDING A MICROPROGRAMMED COMPUTER

With these available building blocks we can now

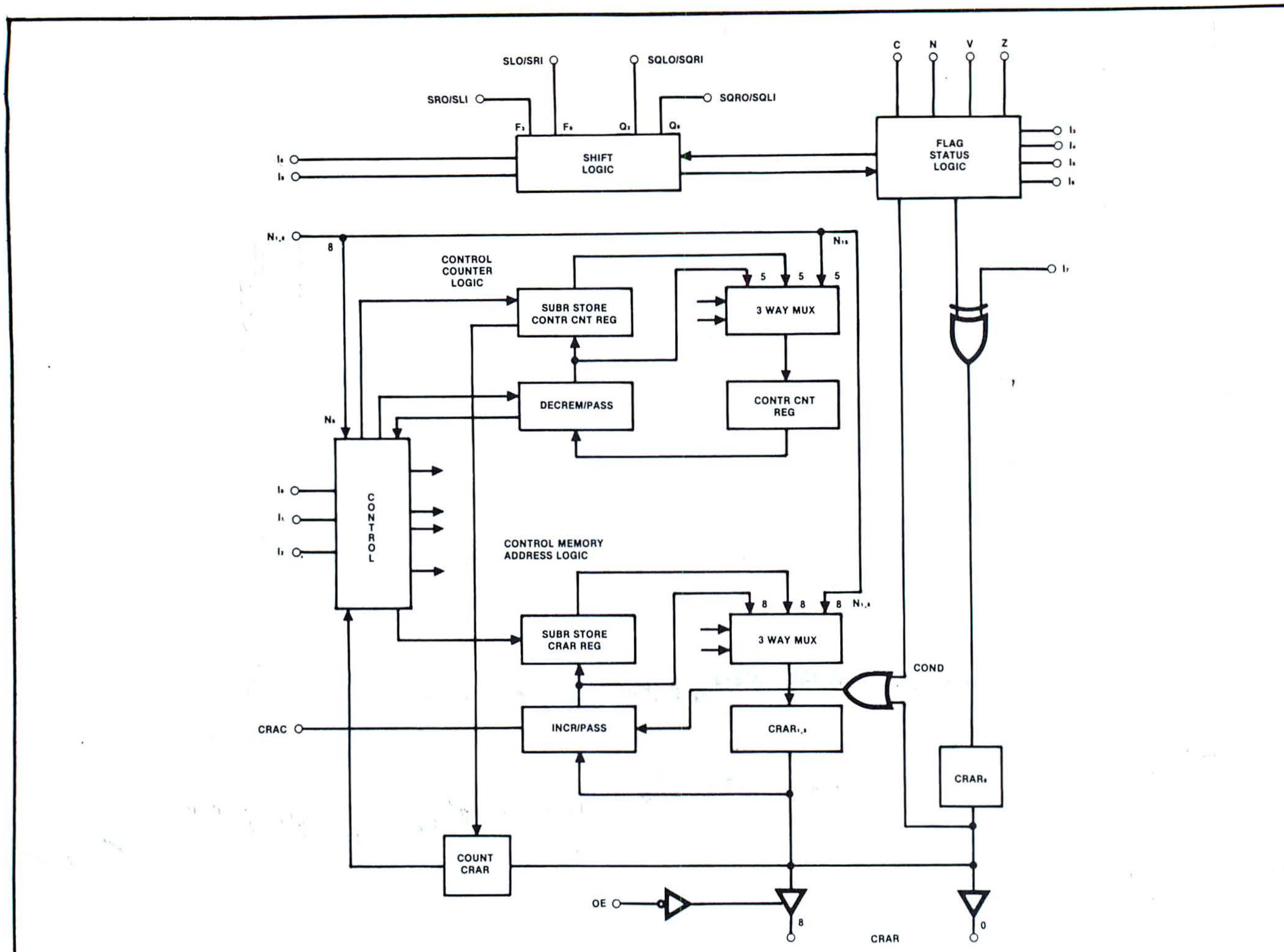


Figure 6. Block Diagram of a 57110 Microprogram Control Unit

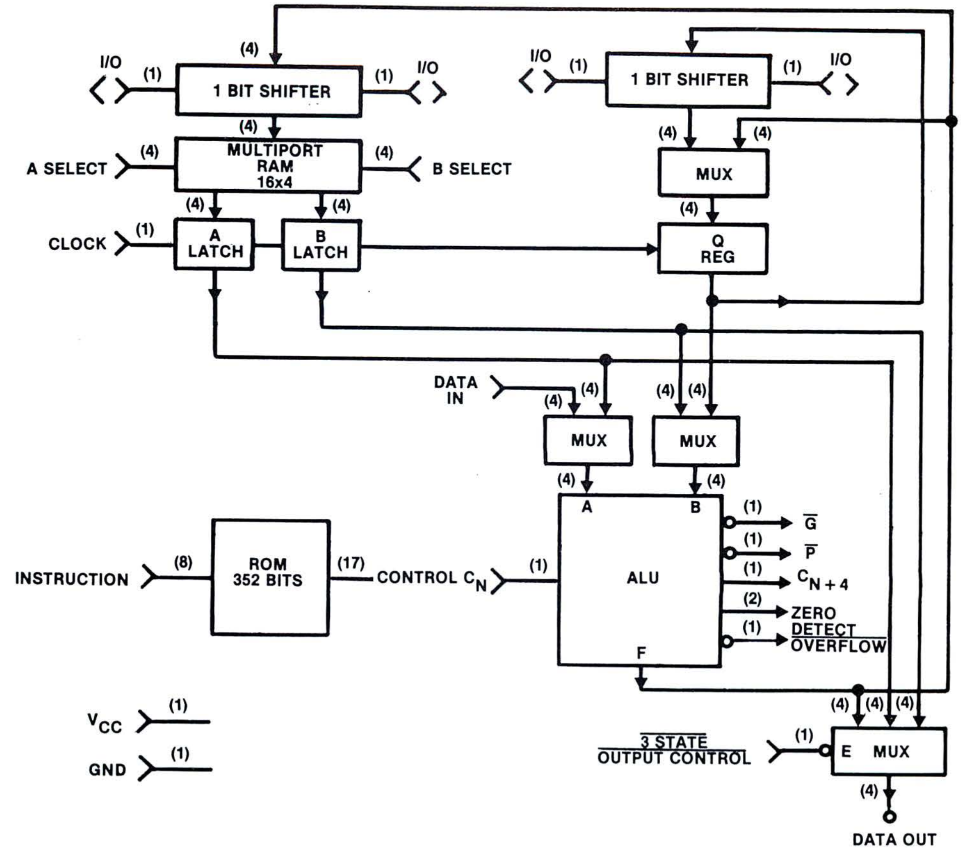


Figure 7. Block Diagram of a 6701 Microcontroller

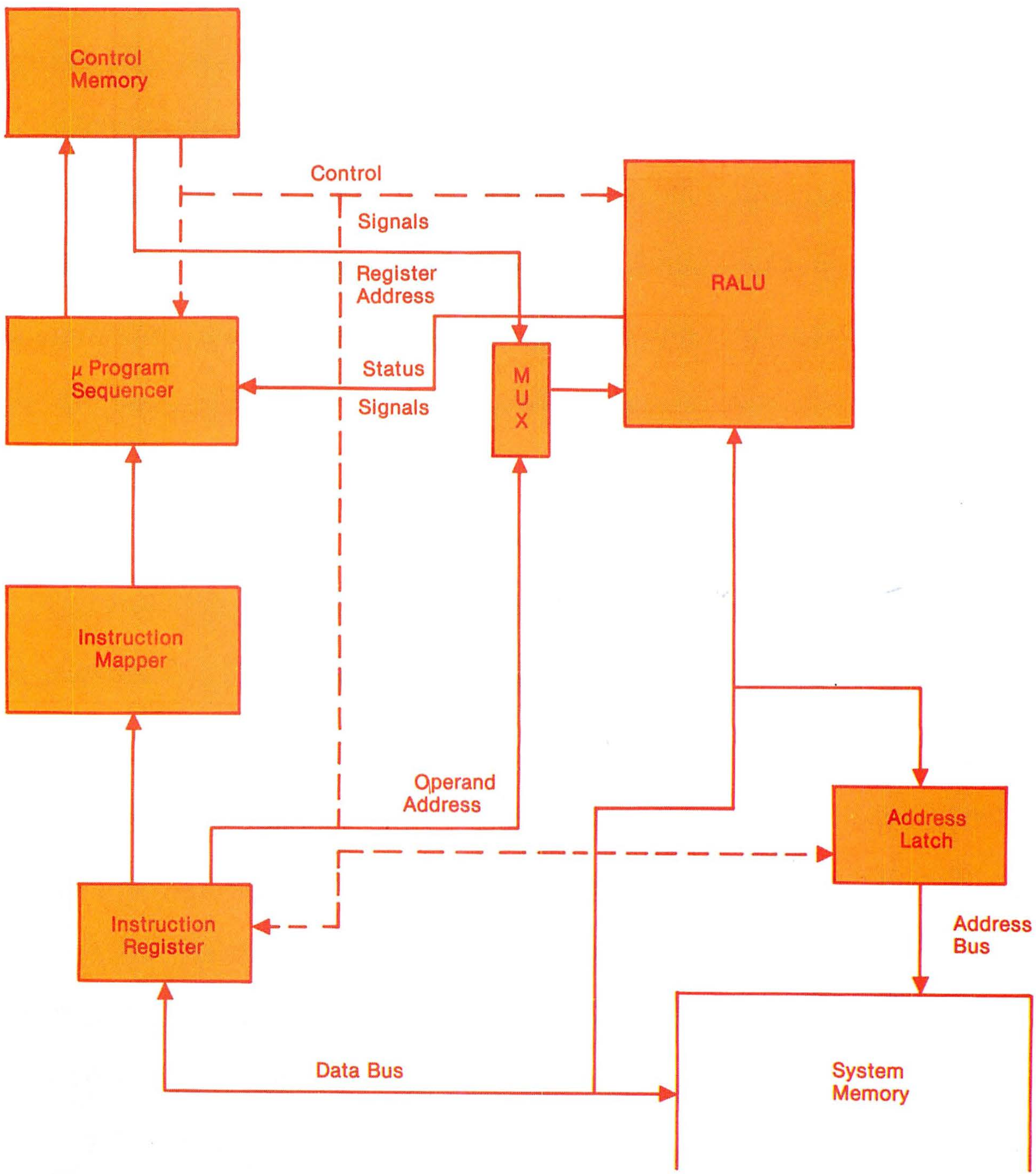


Figure 8. Block Diagram of a Microprogrammed Computer

design a microprogrammed computer that can be used to emulate some of the available microprocessors. Emulation is the process of microprogramming one computer to execute the machine-level language instructions of another computer. If we can build a microprogrammed computer that can emulate some of the more widely used microprocessors, we can run programs written for them.

Figure 8 shows a block diagram of a system that could be used to emulate a microprocessor. The system can easily be built using some of the devices that have already been discussed. The RALU performs the arithmetic logic operation, stores data in its internal registers and is involved in calculating the next machine level language instruction address. The microcontrol sequencer is used to determine the next microinstruction address. The control memory is part RAM and ROM. The ROM section is used to allow loading the RAM portion with a new microprogram. The size of this memory will have to be about 1K by 48. The instruction mapper translates from machine level instruction to the starting address of the section of microprogram that will emulate the instruction. The instruction register holds the current machine level instruction. The address latch is used because most of the bit-slice controllers do not have a separate program counter and address output port. The RALU under microprogram control calculates the next memory address and stores it in the address latch. System memory is the memory that would be with any computer system.

A typical machine level instruction execution would proceed as follows:

1. The microprogram increments the register that is being used as a program counter and stores the result back into the register and also into the address latch.
2. The next micro sequence causes the instruction to be fetched from memory and stored in the instruction register.
3. The OP code portion of the instruction is used to determine the starting microprogram address. A ROM, PLA or just logic gates can be used to perform this task. After the address has been determined, it is stored in the microprogram sequencer.
4. Simple operations like add and/or subtract can be performed in only one micro-operation. Other operations like skip on zero would require testing flags then modifying the program counter depending on results.
5. When the microprogram is complete, another machine level instruction is fetched.

ADVANTAGES OF MICROPROGRAMMING

In a microprogrammed machine the design is independent of software or desired instruction set. The instructions do not have to be defined until after the design is complete. These machines can be used to emulate other computers. The cost of building this type of computer is higher than the cost of microprocessors because of the large control memory. Approximately 36-to 50-bit words are required to build a microprogrammed computer. With the new LSI building blocks, the cost of building a microprogrammed computer has come down.

REFERENCES:

1. "Microprogramming and the Design of the Control Circuits in an Electronic Digital Computer" - M. V. Wilkes/J. B. Stringer, *Computer Structure Readings and Examples,* C. G. Bell, Allen Newell, McGraw-Hill 1971.
2. *Microprogramming Handbook,* John R. Mick, Jim Brick - Advanced Micro Devices Inc. 1976.
3. *Microprogram Controller 57110/67110* Specification Sheet - Monolithic Memories 1976.
4. *4-Bit Expandable Bipolar Microcontroller 5701/6701* Specification Sheet - Monolithic Memories 1974.

INTRODUCING THE S-100: STANDARD SMALL COMPUTER BUS STRUCTURE

by W. M. Goble

The bus structure and packaging originally used on the Altair 8800™[1] computer is rapidly becoming the standard of small computer systems. At the present time, there are at least forty manufacturers making electronically and mechanically compatible products of every conceivable type using this bus structure, known as the S-100.

With super-cheap memory boards, up to 16K per board, fast audio cassette and video interface boards, microprocessing boards for many different microprocessors, and even calculator boards, floppy disk controllers, and speech synthesizers, the owner of an S-100-based computer should have no problem putting together his "special" system without depending on one manufacturer or even one microprocessor.

The standard circuit board size for S-100 systems is 5.3 inches by 10 inches (Figure 1). All S-100 circuit boards have a 100-position card edge connector with .125 inch spacing at the bottom. The connector is offset to prevent backwards insertion of a circuit card. Figure 2 shows a list of the S-100 bus designations with an extensive but not complete chart of which connections are used by various manufacturers.

These lines on the S-100 can be divided into three sections: (1) address bus, (2) data bus, (3) control bus.

There are sixteen address lines on the S-100 allowing 65,536 bytes of memory to be uniquely addressed. These lines are:

A0 - PIN 79	A4 - PIN 30	A8 - PIN 84	A12 - PIN 33
A1 - PIN 80	A5 - PIN 29	A9 - PIN 34	A13 - PIN 85
A2 - PIN 81	A6 - PIN 82	A10 - PIN 37	A14 - PIN 86
A3 - PIN 31	A7 - PIN 83	A11 - PIN 87	A15 - PIN 32

The address lines are generated by either the microprocessor or a direct-memory-access device and are decoded by each memory circuit so that only one memory location is addressed by an exclusive bit pattern.

[1]Trademark of MITS, Inc.

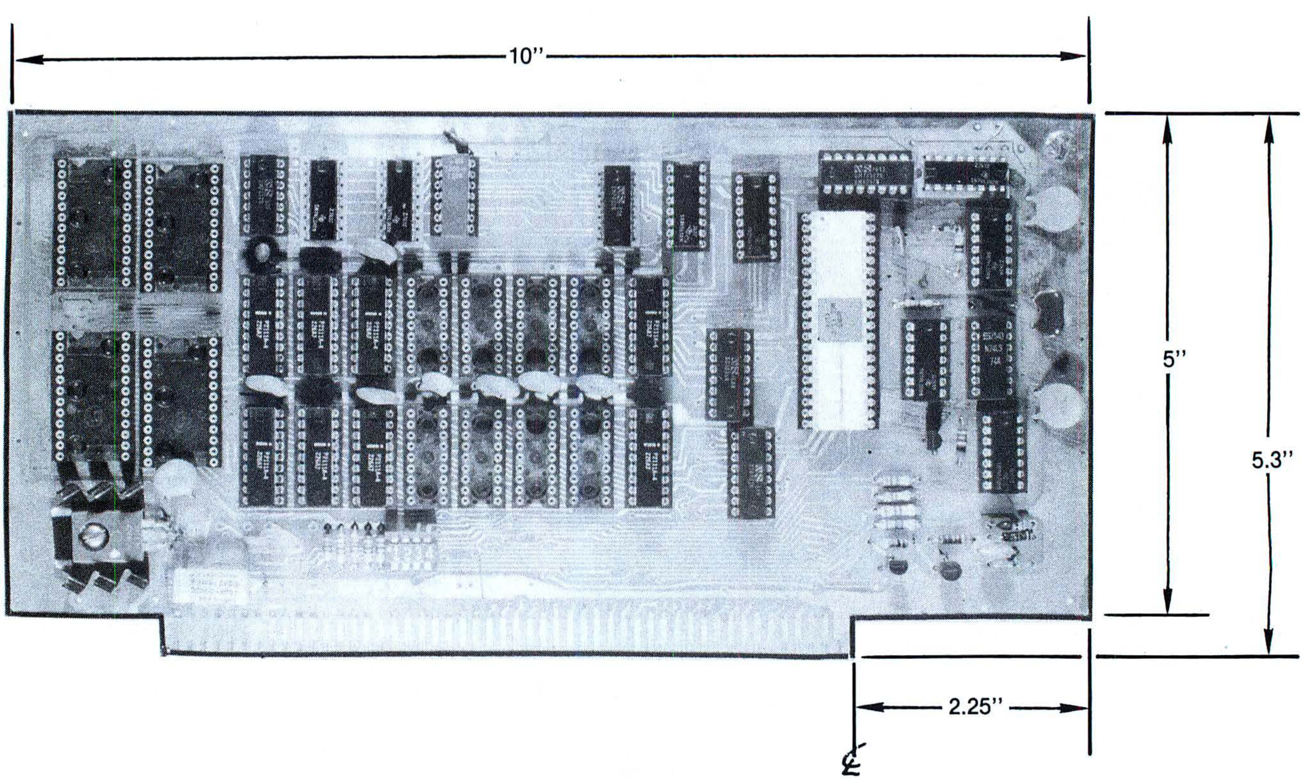


Figure 1. S-100 Card Size. Photograph of CGRS 6502 Computer Board.

Figure 2. S100 Listing

Pin	ALTAIR 8080 CPU	CGRS 6502 CPU	MORROW 8080 CPU	MRS 6800 CPU	-T.D.L.- Z80 CPU	IMSAI 4K RAM	PROC TECH 4K RAM	DUTRONIC 8K RAM	TDL 16K RAM	CROMEMCO 8K ROM	POLYMORPHIC VIDEO	PROC TECH VIDEO	TARBELL CASSETTE	CGRS SYSTEM I/O	TV DAZZLER®	MERLIN VIDEO/I-O
51. +8 VOLTS	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
52. –16 VOLTS	X	X	X						X	X	X	X	X	X		X
53. SSW DIS	X		X		X											
54. EXT CLR		X		X												
55. RTC																
56. *																
57. *																
58. *																
59. *									X							
60. MBS*										X	X	X	X	X	X	X
61.																
62.																
63.																
64.																
65.																
66.																
67. *																X
68. MWRITE		X				X	X	X	X	X	X	X		X		X
69. $\overline{\text{PS}}$			X				X			X						
70. PROTECT			X				X									
71. RUN	X			X	X											
72. READY 2	X	X	X	X	X	X				X		X				X
73. $\overline{\text{INT REQ}}$	X	X	X		X						X			X		X
74. $\overline{\text{HALT}}$	X	X	X	X	X											X
75. $\overline{\text{RESET}}$	X	X	X	X	X								X	X		
76. PSYNC	X	X	X	X	X		X	X	X	X	X	X				X
77. $\overline{\text{WR}}$	X	X	X	X	X	X						X	X			X
78. DBIN	X	X	X	X	X		X	X				X	X			X
79. A0	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
80. A1	X	X	X	X	X	X	X	X	X	X	X	X		X		X
81. A2	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
82. A6	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
83. A7	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
84. A8	X	X	X	X	X	X	X	X	X	X	X	X		X		X
85. A13	X	X	X	X	X	X	X	X	X	X	X	X		X		X
86. A14	X	X	X	X	X	X	X	X	X	X	X	X		X		X
87. A11	X	X	X	X	X	X	X	X	X	X	X	X		X		X
88. DO2	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
89. DO3	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
90. DO7	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
91. DI4	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
92. DI5	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
93. DI6	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
94. DI1	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
95. DI0	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
96. INTA	X		X		X											
97. $\overline{\text{SWO}}$	X	X	X	X	X											
98. SSTACK	X		X													
99. $\overline{\text{POC}}$	X	X	X		X						X					
100. GROUND	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X

Pin	ALTAIR 8080 CPU	CGRS 6502 CPU	MORROW 8080 CPU	MRS 6800 CPU	-T.D.L.- Z80 CPU	IMSAI 4K RAM	PROC TECH 4K RAM	DUTRONIC 8K RAM	TDL 16K RAM	CROMEMCO 8K ROM	POLYMORPHIC VIDEO	PRO TECH VIEDO	TARBELL CASSETTE	CGRS SYSTEM I/O	TV DAZZLER®	MERLIN VIDEO/I-O
1. +8 VOLTS	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
2. +16 VOLTS	X		X						X	X	X	X		X		X
3. READY 1	X	X	X		X		X	X				X		X		
4. VI0		X			X							X				X
5. VI1																
6. VI2																
7. VI3																
8. VI4																
9. VI5																
10. VI6																
11. VI7																
12. READY 3*				X												
13. *				X												
14.																
15.																
16.																
17.																
18. $\overline{\text{STATUS DIS}}$	X		X	X	X											X
19. $\overline{\text{C/C DIS}}$	X		X	X												X
20. UNPROTECT			X				X									
21. SINGLE STEP	X				X											
22. $\overline{\text{ADD DIS}}$	X		X	X	X											X
23. $\overline{\text{DO DIS}}$	X		X	X	X											X
24. 02	X	X	X	X	X		X					X		X		X
25. 01	X	X		X	X				X		X					X
26. HLDA	X	X	X	X	X											X
27. WAIT	X	X	X		X	X										X
28. INTE	X		X		X											
29. A5	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
30. A4	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
31. A3	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
32. A15	X	X	X	X	X	X	X	X	X	X	X	X		X		X
33. A12	X	X	X	X	X	X	X	X	X	X	X	X		X		X
34. A9	X	X	X	X	X	X	X	X	X	X	X	X		X		X
35. DO1	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
36. DO0	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
37. A10	X	X	X	X	X	X	X	X	X	X	X	X		X		X
38. DO4	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
39. DO5	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
40. DO6	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
41. DI2	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
42. DI3	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
43. DI7	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
44. SMI	X	X	X		X											
45. SOUT	X	X	X	X	X	X	X	X	X	X		X	X	X		X
46. SINP	X	X	X	X	X	X	X	X		X	X	X	X	X		X
47. MEMR	X	X	X	X	X	X	X	X	X	X	X			X		X
48. HLTA	X	X	X		X											
49. $\overline{\text{CLOCK}}$	X	X	X		X						X					
50. GROUND	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X

*PINS IN CONFLICT: USED FOR DIFFERENT PURPOSES IN EACH COMPUTER

The S-100 bus structure provides an 8-bit data bus with separate data input and data output lines. The data input lines are:

D10 - PIN 95	D14 - PIN 91
D11 - PIN 94	D15 - PIN 92
D12 - PIN 41	D16 - PIN 93
D13 - PIN 42	D17 - PIN 43

These data input lines carry information from memory or input/output cards to the microprocessor card. The data output lines are:

D00 - PIN 36	D04 - PIN 38
D01 - PIN 35	D05 - PIN 39
D02 - PIN 88	D06 - PIN 40
D03 - PIN 89	D07 - PIN 90

The data output lines carry information from the microprocessor card to the memory or input/output cards.

The remaining lines on the S-100 bus are control lines. They are used for timing, synchronization, data directional control, and computer status control. Since the S-100 was originally used with an Intel 8080 based computer, many of the control line names come directly from the 8080 data sheet. The control lines used for timing and synchronization are:

01 CLOCK	- PIN 25	PSYNC	- PIN 76
02 CLOCK	- PIN 24	READY 1	- PIN 3
$\overline{\text{CLOCK}}$	- PIN 49	READY 2	- PIN 72
SMI	- PIN 44	WAIT	- PIN 27

Clock signals, 01 and 02, along with $\overline{\text{CLOCK}}$ are generated by the microprocessor clock circuit and these lines are the main system timing lines. The two-phase clock lines 01 and 02 are those used by the microprocessor. $\overline{\text{CLOCK}}$ is the output of the oscillator used to generate the 01 and 02 signals. Since some microprocessors such as the 6502 have the oscillator built into the chip and some microprocessors such as the Z-80 use only a single phase clock, there are variations in these three signals among MPU boards. SMI is a status signal that indicates when the microprocessor begins an instruction cycle with an OPCODE fetch. PSYNC is a signal from the 8080 microprocessor that indicates the beginning of each machine cycle. Since the newer microprocessors, such as the 6502, 6800, and Z-80, have less complicated timing requirements, some CPU cards must simulate this signal. READY 1 and READY 2 are inputs to the microprocessor card used to stop the microprocessor if memory devices are not fast enough. The WAIT line acknowledges that the microprocessor has stopped. A simple circuit used to generate a 1-cycle delay with most MPU cards is shown in Figure 3 along with typical circuitry from the MPU card.

Direct-Memory-Access control lines are:

$\overline{\text{HALT}}$ - PIN 74 — $\overline{\text{HLDA}}$ - PIN 26

Direct access to the S-100 bus can be had by pulling the $\overline{\text{HALT}}$ input of the microprocessor card to logic 0. When HLDA (Halt Acknowledge) goes to logic 1, the microprocessor halts operation and its output lines (address, control, and data output) are disconnected from the bus. In some microprocessor cards, such as the CGRS Microputer™[2], the lines automatically disconnect from the bus through "tri-state" buffers. In other microprocessor cards, such as the Altair 8800, external circuitry must pull the output disable lines to logic 0. These microprocessor card disable lines are:

$\overline{\text{STATUS DISABLE}}$ - PIN 18	$\overline{\text{DATA OUT DISABLE}}$ - PIN 23
$\overline{\text{ADDRESS DISABLE}}$ - PIN 22	$\overline{\text{C/C DISABLE}}$ - PIN 19

[2]Trademark of CGRS MICROTECH, INC.

FREE YOURSELF FROM THE ONE BYTE WORLD. MOVE UP TO THE TWO BYTE **TEXAS INSTRUMENTS TMS-9900 16-BIT MICROPROCESSOR** — WITH OUR — **"SUPER STARTER SYSTEM"** — TEC-9900-SS. SHOWN ABOVE, FEATURES HARDWARE MULTIPLY AND DIVIDE, 69 MINI-COMPUTER INSTRUCTIONS, 7 ADDRESSING MODES, EXPANDABLE TO A FULL 65K BYTES; MONITOR, TMS 9900 CPU, RAM, P-ROM, E-PROM, PROGRAMMER ALL ON ONE P-C BOARD BASIC OPERATING SYSTEM AS LOW AS **$299 UNASSEMBLED $399 ASSEMBLED AND TESTED** EXPLICIT **MANUAL** INCLUDED OR AVAILABLE SEPARATELY AT **$35,** TO LEARN MORE . . .JUST TEAR OFF A PIECE OF THIS AD, PIN TO YOUR LETTERHEAD & RETURN TO TECHNICO OR **CALL OUR HOTLINE 1-800/638-2893** TO RECEIVE FREE INFO-PACKAGE. --- DESIGN & TECH SUPPORT BY ROSSE CORP.

CIRCLE INQUIRY NO. 28

TECHNICO
INCORPORATED

9130 Red Branch Rd.
Columbia, Md. 21045
301-596-4100

THE TECHNOLOGY LEADER IN ELECTRONICS DISTRIBUTION

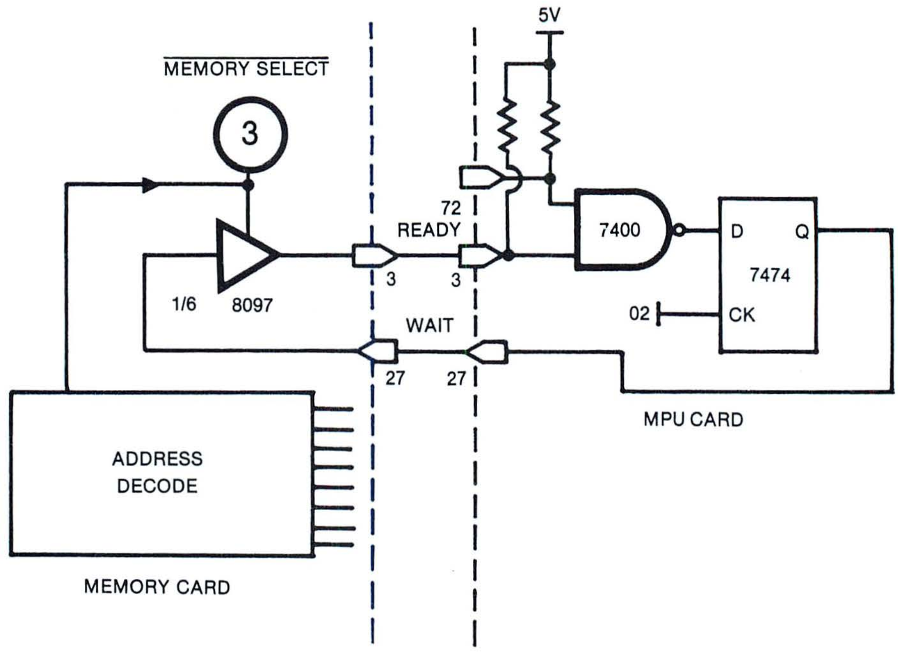


Figure 3. One-Cycle Delay Circuit

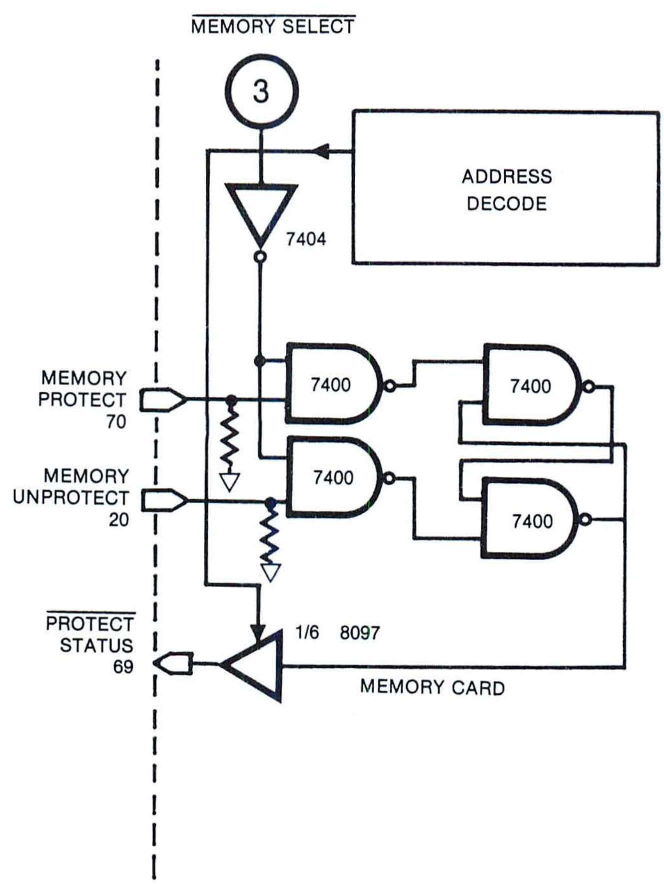


Figure 4. S100 Memory Protect Circuit

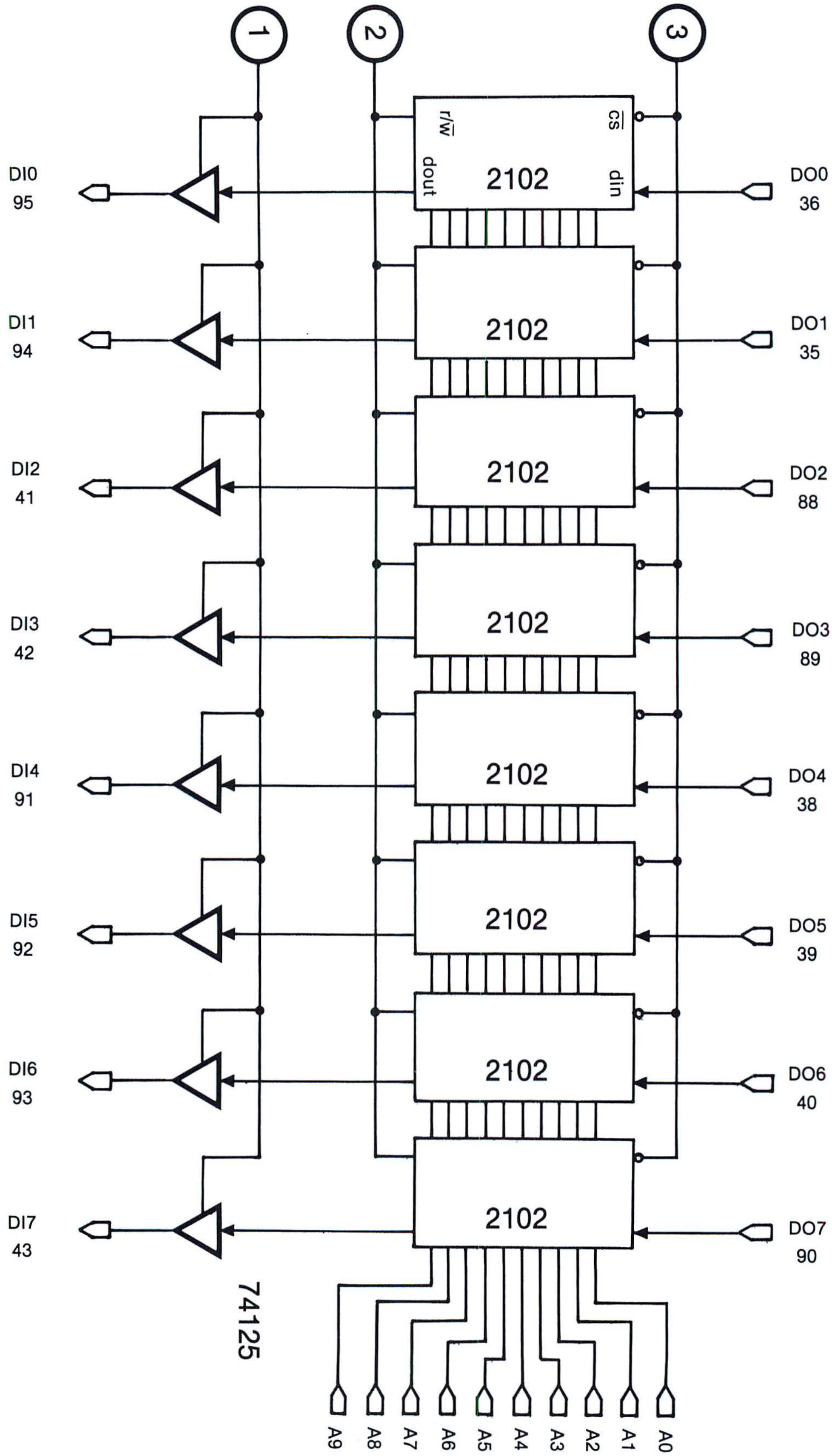


Figure 5. 1K x 8 Memory: 2102

During normal operation, the microprocessor reads and writes to memory and I/O and generates outputs to control the data direction.

DBIN (DATA BUS IN) - PIN 78	MWRITE (MEMORY WRITE)-PIN 68
$\overline{\text{WR}}$($\overline{\text{WRITE}}$) - PIN 77	MEMR (MEMORY READ) -PIN 47

DBIN is a read strobe. This line goes to logic 1 when the microprocessor inputs information from the data bus. $\overline{\text{WR}}$ is a write strobe and goes to logic 0 when the microprocessor is writing and the data is stable. Memory Read and Memory Write control data direction in memory cards and I/O cards wired like memory.

The S-100 has two special lines used to activate I/O boards, SINP - PIN 46 and SOUT - PIN 45. If either of these lines go to logic 1, all memory boards are disabled. SINP is used to activate input "ports" and SOUT is used to activate output "ports". Many microprocessors other than the 8080 treat I/O exactly like memory and do not generate SINP and SOUT. Because of this, some newer design I/O boards are decoded as memory and can be used with all microprocessors.

Another group of lines controls the microcomputer program flow. These lines are the "interrupt" groups.

VI0 thru VI7 PINS 4, 5, 6, 7, 8, 9, 10, 11

$\overline{\text{EXTERNAL CLEAR}}$ - PIN 54	$\overline{\text{RESET}}$ - PIN 75
$\overline{\text{IRQ}}$ - PIN 73	$\overline{\text{POC}}$ (Power on Clear) - PIN 99

The "reset" lines, PIN 54, PIN 75, and PIN 99, all reset the microcomputer system from different sources and in some MPU cards these lines are all tied together. Pins 4 thru 11 are "vectored interrupt" lines. A vectored interrupt system is used when very fast multiple interrupt response is required and is implemented with a special circuit card.

The $\overline{\text{IRQ}}$ line is the "interrupt request" input to the MPU card. This line is used by itself when only one interrupt is required or when multiple interrupts can be accommodated with software. The interrupt enable from the 8080 microprocessor is connected to pin 28. This line is used to disable the $\overline{\text{IRQ}}$ input. Some microprocessors provide an interrupt acknowledge output (INTA -PIN 96).

The S-100 has some unique control lines that provide very convenient features. One of these is the "remote memory protect." Some memory boards (Figure 4) designed for the S-100 bus have a memory protect flip-flop on board. A momentary positive pulse on the MEMORY PROTECT line, PIN 70, will set the flip-flop on the board that is active and this memory cannot accept data. A momentary positive pulse of the MEMORY UNPROTECT line, PIN 20, will reset the flip-flop and $\overline{\text{PS}}$, Pin 69, indicates the flip-flop output. A real time clock signal is also on the S-100 bus. PIN 55 provides a 60 Hertz pulse for timing and additional clock applications.

The power lines on the S-100 bus are:

+ 8 Volts - PIN 1, 51	– 16 Volts - PIN 52
+ 16 Volts - PIN 2	Common -PIN 50, 100

Each printed circuit card has one or more voltage regulators on-board. This system allows the use of cheap, unregulated power supplies along with cheap 3-terminal regulators. The 8-volt line is regulated to 5 volts; other positive and negative supplies are derived from the 16 volt lines.

MEMORY FOR THE S-100

In order to illustrate exactly how some of these lines are used, some typical memory circuits can be hooked up to the S-100 bus. A 1K memory system using 2102-type memories is shown in Figure 5. This block of memory requires three control lines:

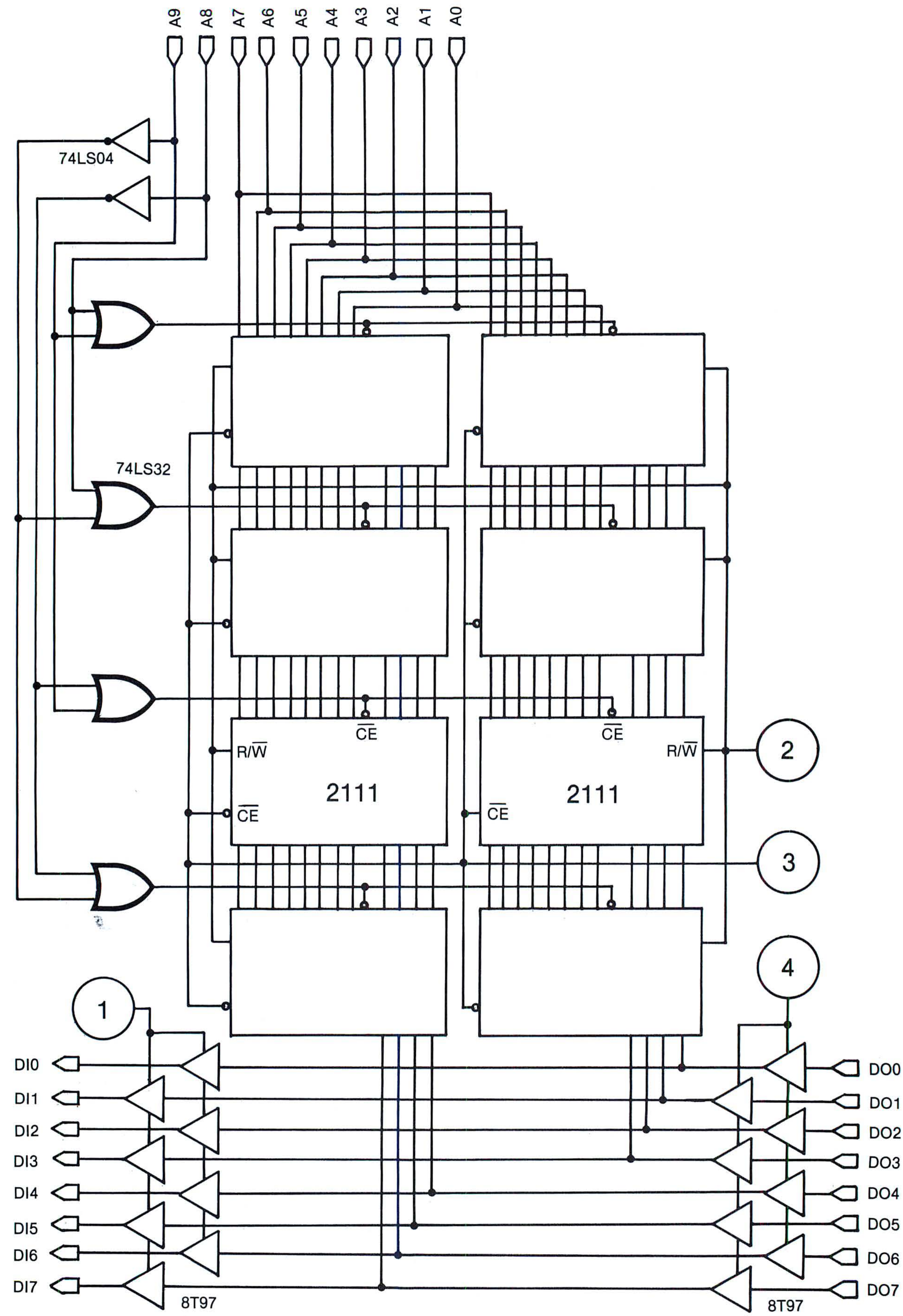


Figure 6. 1K x 8 Memory: 2111

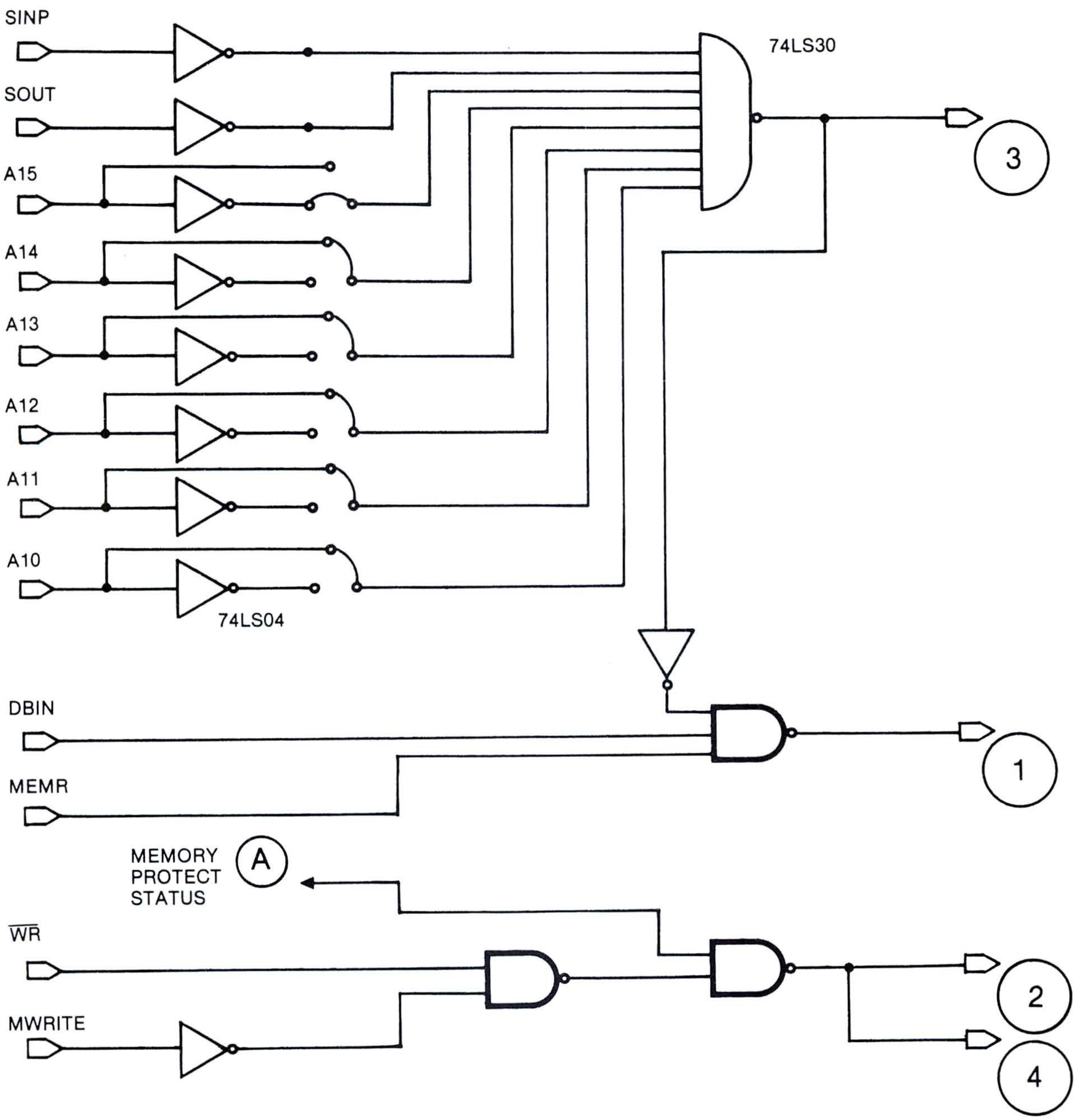


Figure 7. S100 Interface.

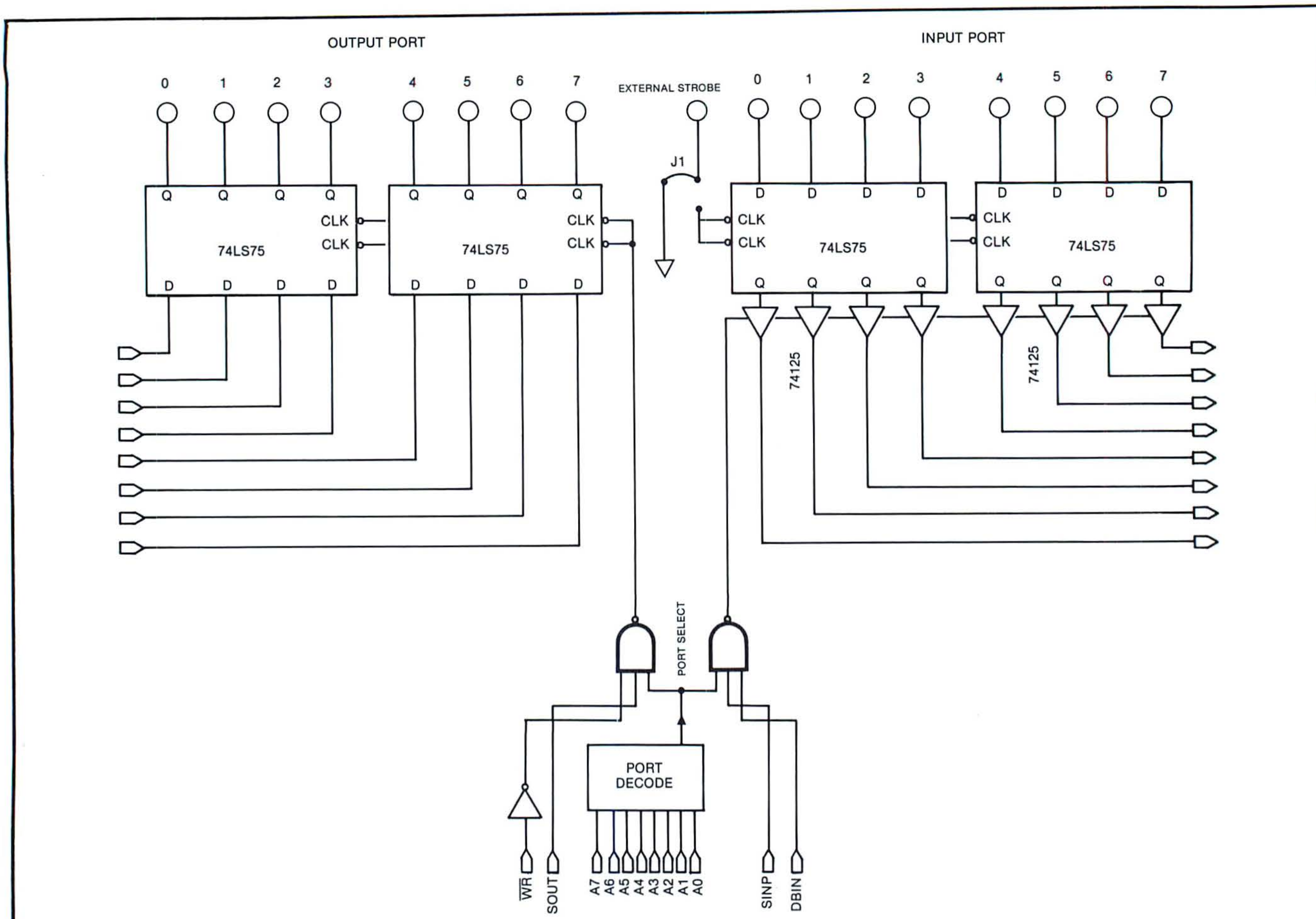


Figure 8. I/O Port: Port Decoding

 CIRCLE INQUIRY NO. 64

1. OUTPUT ENABLE - This signal activates the output buffer gates. When OUTPUT ENABLE switches to logic 0, the buffer gates switch from their high impedance or "tri-state" mode to an active output mode. They will then supply information to the data input bus of the S-100.

2. READ/WRITE - This signal tells the memory if it will be read from or written into. A logic 1 indicates read and a logic 0 indicates write.

3. MEMORY SELECT - This signal activates a particular block of memory. When MEMORY SELECT is low, the memory chips are active. When this signal is high, the memory chips are inactive and cannot be read from or written into.

Another 1K memory circuit using 2111-type memories is shown in Figure 6. The 2111-type memory has bi-directional data transfer. This memory circuit requires four control lines, three of which are identical to the previous circuit.

1. OUTPUT ENABLE
2. READ/WRITE
3. MEMORY SELECT
4. INPUT ENABLE

INPUT ENABLE - This signal enables the input buffers. When it switches to logic 0, the input buffer gates switch from the high impedance mode to an active output mode, transferring data information to the memory from the data out bus of the S-100.

The circuitry required to generate these signals from the control lines on the S-100 bus is shown in Figure 7. The most significant address bus bits are decoded along with SINP and SOUT to provide the MEMORY SELECT line. SINP and SOUT are normally at logic 0 and switch to logic 1 when some microprocessors do input/output operations. The memory should be disabled at that time. In this circuit the "location" of the memory is selectable by placing wire jumpers from address lines to the inputs of the 74LS30.

The output buffers are enabled when DBIN and MEMR reach logic 1 and when the memory is selected. This means that (1) the data bus is in the input mode, (2) the microprocessor wants to read from memory, and (3) this is the memory from which the microprocessor wants to read. Some manufacturers have omitted DBIN from their memory cards and some manufacturers have omitted the MEMR signal from this circuit. This can most certainly be done, depending on the memory type used and the MPU timing requirements.

The READ/WRITE control line can be generated from either MWRITE or WR or both. MWRITE switches to logic 1 to indicate when memory is being written to. WR switches to logic 0 to indicate that the microprocessor is writing and that the data is stable. In original S-100 computer design, the MWRITE line came only from the front panel and could be missing from systems used without a front panel. WR and MWRITE are both microprocessor output signals, and your choice of one or both would depend on system cards being used. If the memory card has a "memory protect" flip-flop on board, the PS (Protect Status) line is used to inhibit the memory write mode.

The input buffers can be controlled with the same signal that controls memory read and write. The input buffers should turn on only when the memory is receiving information from the microprocessor. This happens when the memory is in the write mode.

I/O ON THE S-100

The availability of many new and unique I/O boards for the S-100 computer gives the owner a tremendous advantage in system configuration. The many products that simply plug into the S-100 include:

1. High speed cassette interface
2. Complete floppy disc systems
3. Speech synthesizers
4. A.C. power control units
5. Realtime clock, calendar, timing board
6. Calculator boards
7. Multi-function system I/O boards
8. Video monitor interface
9. Color television display boards
10. Analog input-output boards

These I/O boards operate in one of three ways:

1. PORT — The I/O card is decoded as a "port" - one of the 256 special locations activated when SINP or SOUT control lines switch to logic 1. The port number is transmitted by the microprocessor over address lines A0 through A7. The 8080 microprocessor repeats the port number on address lines A8 through A15 and some manufacturers decode these bits.

2. UNIVERSAL — The I/O card is decoded exactly like computer memory and the microprocessor loads it with information exactly the same way as it stores information in memory.

3. DIRECT MEMORY ACCESS (DMA) — The I.O card halts the microprocessor and reads the computer memory, extracting the information and then returning control of the bus to the microprocessor.

The circuitry for a simple 8-bit input and output latch is shown in Figure 8. The 74LS75 is a quad D flip-flop whose output follows the D input as long as the clock line is at logic 0. When the Clock line switches to logic 1, the information on the D inputs is latched onto the output and cannot change. The output latch receives new information whenever (1) the gates decode its port number, (2) SOUT switches to logic 1, and (3) $\overline{WR}$ switches to logic 0. This tells the I/O latch that the microprocessor is writing to an output port and that this is the output port to which to be written.

This input port can operate in two ways depending on the position of J1. An 8-bit word can either be latched into this input port with an external strobe signal or the flip-flop output will follow its input. The flip-flop outputs will send their information to the microcomputer data input bus when the 74125 "tri-state" buffer gates turn on. These buffer gates turn on when the microcomputer is in the input mode (SINP logic 1), the data bus is in the input mode (DBIN = logic 1), and the input port is selected.

The same I/O latch can be decoded as memory (Figure 9). The I/O latch operates exactly as before, but this "universal" type decoding allows the 8080 programmer to use the complete set of memory reference instructions when addressing the I/O. The universal-type I/O is the only type the 6800 and 6502 can use conveniently since neither generates special SINP and SOUT control lines, and it would appear that the universal-type I/O is preferable for those who expect to use more than one type of microprocessor.

The S-100 is not completely standardized. There are variations in some control lines from different manufacturers. In addition, since the bus was originally defined for the 8080 microprocessor only, the timing and control lines are more complicated than they need be and there is no need for bi-directional data bus. Despite these problems the fact remains that an unbelievable number of independent manufacturers have managed to build their products so that they fit together. The owner of an S-100-based computer can expand his system by simply plugging in a card, and he can choose among more types than with any other computer. Hopefully, the small problems and inconsistencies soon will be cleared up and we can all benefit from a completely standard small computer bus structure, the S-100.

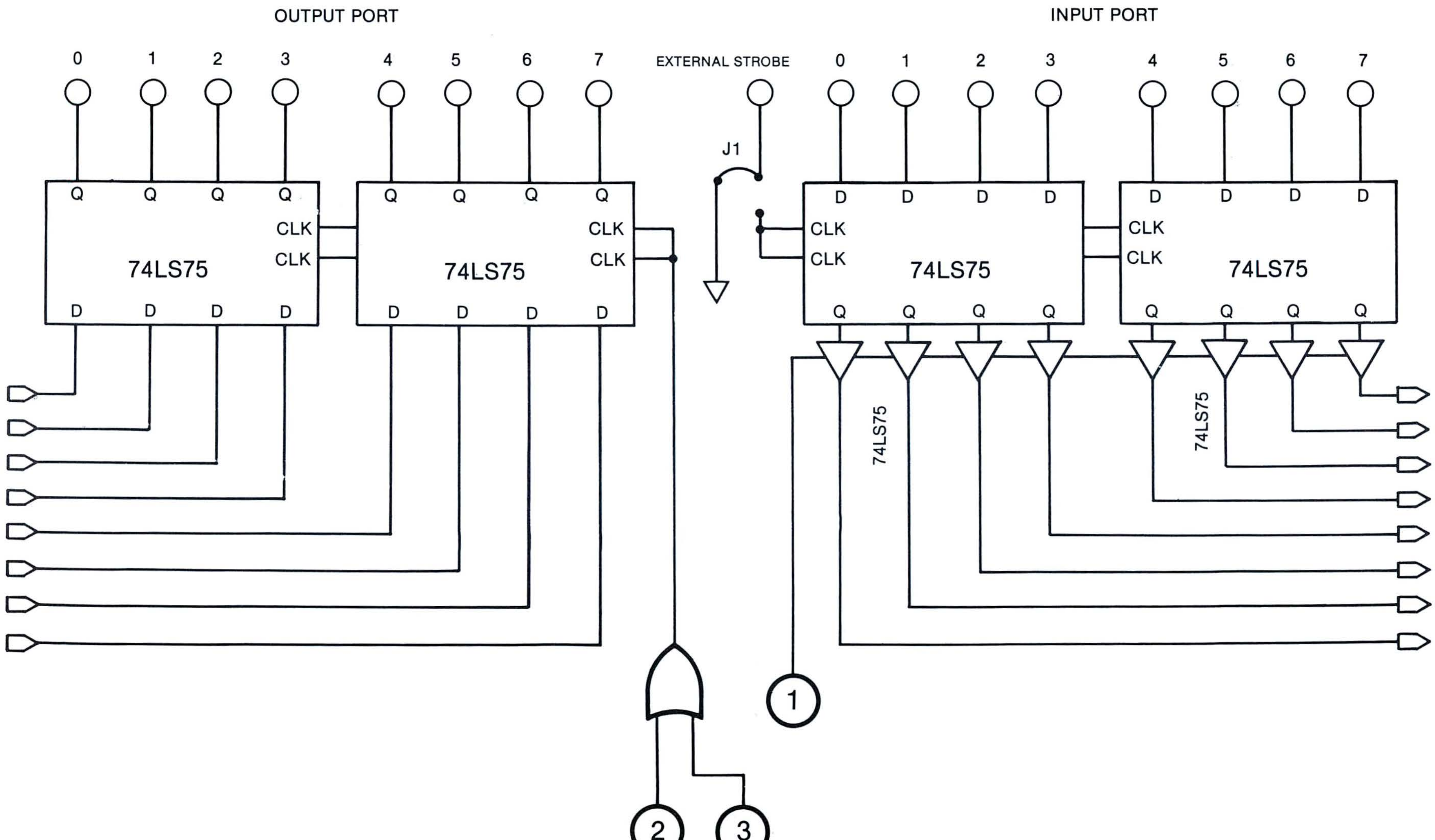


Figure 9. I/O Port: Memory Decoding


THE
DUMB TERMINAL
FAN CLUB HEADQUARTERS
THE
DUMB
TERMINAL
THE
DUMB
TERMINAL
THE
DUMB
TERMINAL

NEW PRODUCTS

NMOS Microcomputer Kit—An Educator II

Motorola's HEP/MRO Operations group, introduced an 8-bit microcomputer system in kit form, is called the Educator II. The kit contains an NMOS 8-bit MPU, PIA, 128x8-bit static RAM; two TTL 512x4-bit ROMs and a TTL clock circuit. The NMOS components are the HEP versions of the popular M6800 microcomputer products. Educator II utilizes the full instruction set and address modes of the MC6800 MPU. The clock frequency is approximately 624 KHz.

An executive program, residing in the ROMs, contains routines for examining and modifying memory locations and MPU registers, servicing interrupts, transferring programs to and from cassette tapes, searching tapes for specific programs and a routine to test the finished kit. The executive uses 14 bytes of RAM for a scratchpad; the remaining 114 bytes are for user programs. An optional 128x8-bit RAM can be added to the p.c. board for larger user programs.

Educator II is housed in a sturdy aluminum case. Front panel toggle switches and L.E.D.s are used to enter and display machine code. Edge connectors on the p.c. board provide an interface to the PIA and address, data and control busses for system expansion. Educator II accessories planned for the near future include a keyboard kit, video display kit, a module card rack and power supply, memory modules and applications programs on cassettes.

The p.c. board layout is quite simple; kit construction could be accomplished in one evening. All components necessary to get the microcomputer "up and running" are supplied, even the solder. A separate power supply, of course, is required. A Test-As-You-Build feature provides for accurate, minimum error construction.

A comprehensive construction/instruction manual is included with the kit. Nothing is left to chance in the manual, construction steps are explicitly detailed. Theory of operation of the kit's NMOS microcomputer components are described in an articulate manner. The user is "stepped through" increasingly complex demonstration programs, shown the basics of debugging and how to use the cassette operation. Applications programs are described and listed, along with a listing of the resident firmware.

Educator II retails for $169.95 and is available from selected Motorola HEP and MRO distributors and other distributors, nationally. The additional 128x8-bit RAM is also available at the same locations; the retail price is $19.04.

For further information contact: Motorola HEP/MRO National Sales Manager, 705 West 22nd Street, Tempe, Arizona 85282; (602) 244-3208, or the Technical Information Center, Motorola Semiconductor Products, Inc., P.O. Box 20924, Phoenix, Arizona 85036.

CIRCLE INQUIRY NO. 113

Precision Voltage Reference for Instrumentation

A stable 2.5 Volt reference source, type number MC1403/1503 has been introduced by Motorola.

Designed for critical instrumentation and D-A converter applications, the low-cost monolithic circuit features a maximum output voltage variation of only 1% ($\pm$ 25mV) and a typical temperature coefficient of ($\Delta Vo/°\Delta T$) pf 10 ppm/°C.

Laser trimming of resistive networks as a routine process during normal manufacture provides a high yield to a very tight tolerance specification. The laser trimming process adds to the probing time and requires a small amount of additional real estate (compared with non trimmed chips) but effectively increases the tight-tolerance yield to the point that the small cost increase is swamped by the overall cost reductions made possible, compared with device selection to a given spec.

This chip also represents the first utilization of a P-channel J-FET in a linear integrated circuit at Motorola (a relatively new production technology). Ion implantation is the technology responsible for this capability.

Other important circuit specifications include:

Line Regulation = 3mV (max) at input voltage from 4.5 to 15 V.
4.5mV (max) at input voltage from 15 to 40 V.

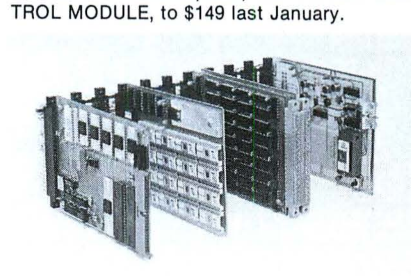
Load Regulation = 10mV (max) at output currents from 1 to 11mA.

For further information, contact Motorola Semiconductor Products, Inc., P.O. Box 20912, Phoenix, AZ 85036, (602) 244-6900.

CIRCLE INQUIRY NO. 114

Wintek Reduces Micro Price

WINTEK has announced a 27% price reduction on their 16K byte WINCE RAM Module. This follows their 50% price reduction on their one card microcomputer, the WINCE CONTROL MODULE, to $149 last January.

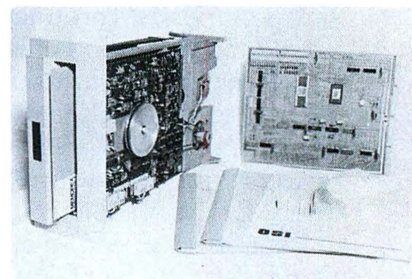


The WINCE MICRO MODULES are unique in that they are the only 6800 based modules available on industry standard 4½" x 6½" printed circuit cards. Other WINCE modules include the ROM, EROM PROGRAMMER, RELAY DRIVER/SENSOR, CONSOLE, INTERFACE, etc. The new (old) prices on the RAM Module are: 16K - $699 ($889); 12K - $575 ($689); 8K -$399 ($489); 4K - $298 ($275). WINTEK Corp., 902 N. 9th Street, Lafayette, IN 47904. (317) 742-6802.

CIRCLE INQUIRY NO. 115

OSI 470B Floppy Disc

The 470B is an upgrade of OSI's popular 470 floppy disc. The new disc features a GSI model 110 disc drive for 240K bytes single density storage or 480K bytes double density storage. The new disc also features a head load indicator and a prefabricated fifty line interconnecting cable. The introductory special for the 470B is $599 for a fully assembled drive and cable harness, 6502 disc operating system, and controller board in kit form.



The drive is also available fully assembled for OSI Challengers including matching case and power supplies for $990. OSI's floppy disc bootstrap prom allows the owner of any OSI system to use his floppy disc immediately on power up and is available for $29 with either version of the 470B.

For further information, contact OSI, Ohio Scientific Instruments, 11679 Hayden Street, Heron, OH 44234.

CIRCLE INQUIRY NO. 116

Booklet Describes Latest Telecommunication Circuits

A new catalog of microprocessors and integrated circuits designed for telecommunications applications, is now available from National Semiconductor Corporation.

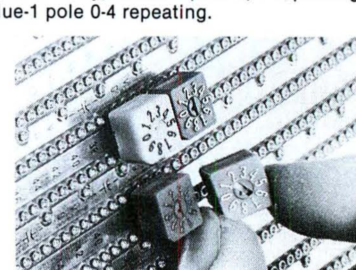
The 12 page booklet contains descriptions, data, and applications notes, and diagrams of twelve different subsystems product lines that are of particular importance to manufacturers and users of modern telecommunications systems equipment.

The booklet is available without charge from National Semiconductor, 2900 Semiconductor Drive, Santa Clara, California 95051, and from National's local sales offices.

CIRCLE INQUIRY NO. 117

Color-Coded Miniature DIP Switch

Color codes have been established for easy recognition of EECO's MICRO-DIP switch output codes when the switches are mounted on a circuit board. Four code colors have been assigned: Red-BCD 1-2-4-8, Orange-BCD Complement only, Green-2 pole 0, 1 repeating and Blue-1 pole 0-4 repeating.



MICRO-DIP is a miniature DIP switch that occupies only one half of a 14-pin DIP socket. It can also be mounted directly on, and electrically connected to, a printed circuit board by hand or flow soldering. MICRO-DIP, only 0.400" x 0.380" x 0.225", is a ten position switch. The 0 to 9 position settings are made by screw driver rotation.

Priced under $1.00 in 10K quantities. Contact: EECO, 1441 East Chestnut Avenue, Santa Ana, CA 92701 or Phone "Switch Products" (714) 835-6000.

CIRCLE INQUIRY NO. 119

New Subsystem Gets Microcomputers Working Faster

Designated Subsystem B, the package is offered in three different modules differing only by amount of memory offered. Users of Subsystem B will find that all the major system elements necessary to get such computers as Altair, Imsai and Comemco Z-2 on the air are provided. Subsystem B includes RAM and PROM memory, parallel, serial, cassette and video display interfaces and software. The software includes a bootstrap loader program to load CUTS 1200 BAUD cassette tapes.

Each of the three packages includes Total Memory (bytes); Display I/O; Parallel, Serial I/O; Tape Cassette I/O and Memory (KRA), plus the new Processor Technology General Purpose Memory (GPM) module which is included at no extra cost. Purchased separately, the GPM is priced at $129. The GPM provides 1024 bytes of low power static RAM, 2048 bytes of preprogrammed ROM or EPROM and space for 8192 bytes of ROM or 2708 type EPROM in addition. The GPM can be used with the new ROM version of the firm's ALS-8 Editor/Assembler software package. Price of the ALS-8/ROM chip set is $159.

Subsystem B is availble from Processor Technology dealers throughout the U.S. and Canada or may be ordered directly from the firm. For prices and more information, please address Processor Technology Corporation, 6200 Hollis Street, Emeryville, CA 94608. Phone (415) 652-8080.

CIRCLE INQUIRY NO. 120

SC/MP Microprocessor Applications Handbook

A new applications handbook for the SC/MP microprocessor is now available from National Semiconductor Corporation. The 150 page manual, which contains detailed information invaluable in building, checking out and operating a host of SC/MP based systems is conveniently organized in capsule form, to enable the designer to expand, modify or customize a particular application with a minimum of effort.

The first chapter deals with general design data, and contains basic SC/MP applications parameters: instruction sets, addressing modes, input/output capabilities, interrupt structures, etc. Additional information on general purpose applications is found in the appendix.

Chapter two has applications data organized into sections according to class: for example, analog to digital/digital to analog systems, keyboard/display systems, multiprocessor systems, and so forth. This method of arranging the information increases referencing convenience, and makes it easier to expand and update information on a particular application.

The handbooks are available for $5.00 each, postpaid, from National Semiconductor Corporation, Marketing Services (520), 2900 Semiconductor Dr., Santa Clara, Calif. 95051.

CIRCLE INQUIRY NO. 121

VIDEO GAME CHIP FOR BLACK—AND—WHITE TV

A new game chip intended for the black and white TV market is now available from National Semiconductor Corporation. The MM5789 is an IC that has tennis, hockey and handball in a format similar to the MM57100, National's color video game chip.

The main difference between the MM5789 and the MM57100, other than color, is in the hockey game. In the MM57100, downfield players engage in random blocking to protect each player's goal. With the MM5789, the downfield players are controlled by the player's paddle.

The game chips may also be integrated directly into a TV set without going through the antenna, requiring only two chips instead of three. The MM5789 generates the composite video, and the MM53104 operates directly with a 3.58 MHz crystal. To accomplish this, the video signal is inserted into the television set at a point after the video detector and the audio are switched into the sound section of the set. In this way, an ordinary black and white TV set may be modified to include games by adding a multipole switch power supply, game chipset and components, and a push-button switch to select the game.

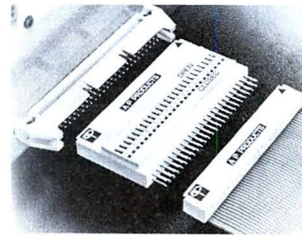
An external RC network, consisting of a fixed capacitor and a variable resistor, gives the vertical paddle positioning. Moving to the top or bottom boundary and pressing the reset button or an external button will change the paddle size. The games are selected in sequence by pushing a button. The score, presented numerically on the TV screen, is blanked automatically when the ball is put into play.

For further information, contact National Semiconductor, 2900 Semiconductor Drive, Santa Clara, CA 95051, Tel. (408)737-5000.

CIRCLE INQUIRY NO. 122

Intra-Switch™

A line of 50 discrete slide switches and both male and female standard double-row flat ribbon cable socket connectors all in a tidy little molded package small enough to get lost in a shirt pocket.



That's Intra-Switch™, the flat cable system testing aid from A P Products Incorporated.

Intra-Switch comes in the five cable line widths most popularly used in ribbon systems: 20, 26, 34, 40 and 50 contacts (lines) wide. It has a female connector at one end, a male at the other, and line-by-line discrete switching in between.

Thus Intra-Switch can plug directly into the line at any point where a connector is incorporated into the ribbon jumper system. Then, as a probe point or pen point moves each switch toward the "OPEN" or "CLOSED" label molded into the Intra-Switch, each line is selectively opened or closed.

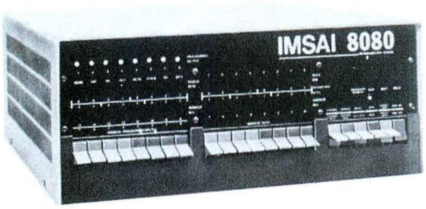
That makes diagnostic and quality testing, programming and selective inhibiting faster and easier, and provides a graphic reference at each switch of the line's status.

Intra-Switch is available through A P Products distributors, who can be located through the company's toll-free Faster And Easier Line, (800) 321-9668. Or write A P Products, 72 Corwin Drive, Box 110, Painesville, Ohio 44077.

CIRCLE INQUIRY NO. 124

ULTRA

THE FORMULA FOR POWER



+ Z-80

= IMSAI Z-80

	Kit	Assembled
IMSAI Z-80 standard (without 8080 CPU)		
with powerful TDL ZPU Board	794.00	994.00
IMSAI Z-80 with 22 slot board	839.00	1039.00
IMSAI 8080 with 6 slot board	594.00	794.00
IMSAI 8080 with 22 slot board	619.00	819.00
for presoldered 22 slot board add $160.00		
(includes cost of connectors and card guides)		
Connectors (for IMSAI)		4.00
Card Guides, one pair (for IMSAI)		1.00
IMSAI 4A-4 RAM Board	129.00	229.00
IMSAI MIO Board	180.00	300.00
IMSAI Priority Interrupt/Interval		
Clock Board	112.50	212.50
IMSAI 1 Port Parallel I/O Board	85.00	125.00
IMSAI 4 Port Parallel I/O Board	140.00	240.00
IMSAI 1 Channel Serial I/O Board	112.50	192.50
IMSAI 2 Channel Serial I/O Board	140.00	240.00
Socket sets for above — call for pricing		
Cable assemblies for above — call for pricing		
ICOM's Frugal Floppy, with Drive, CF 360		
controller, all cables and connectors	N/A	1129.00
ICOM's Frugal Floppy with Dual Drives ...	N/A	1749.00
Complete Dual Drive system with ICOM Dual		
drives, Power Supply, Controller, Interface/		
Software, in a Synetics Designs box	N/A	2445.00

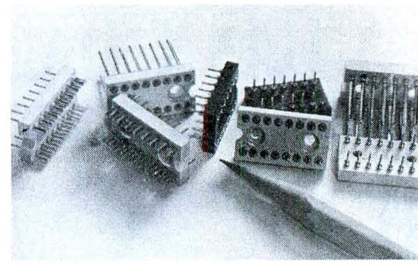
Prices Subject to Change Without Notice

	Kit	Assembled
ICOM's Microfloppy Disk System,		
including Drive, Power Supply,		
Cabinet, Controller/Interface,		
Software, Manuals and Disketttes	N/A	995.00
TDL System Monitor Board	275	355.00
TDL 4K Expandable Memory		
(expandable to 16K)	275.00	189.00
TDL 8K Expandable Memory		
(expandable to 16K)	279.00	339.00
TDL 12K Expandable Memory		
(expandable to 16K)	392.00	482.00
TDL 4K Expansion Modules	135.00	165.00
TDL 16K Memory Board	549.00	669.00
TDL Z-80 ZPU Board	242.00	300.00
OAE Paper Tape Reader (OP-80A)	73.50	88.50
Seals 8K memory board, 500 ns maximum	255.00	300.00
Seals 8K memory board, 225 ns maximum	280.00	340.00
SOROC IQ 120 Intelligent Terminal	990.00	1280.00
Lear Siegler ADM-3A Terminal	875.00	1050.00
OKI Data 110 Printer: 110 CPS dot		
matrix line printer, tractor		
feed with RS232 interface	N/A	1475.00
Merlin Video Board with MBI & MEI	330.00	390.00

NEW PHONE—CALL (714) 731-5197 NOW!

Military Qualification for Sockets Plug-In Electronic Components MIL-S-83734A (USAF)

The Garry Low Profile I.C. Sockets Series 102 and Series 300 are QPL-listed in accordance with the requirements of Specification Sheets M83734/3 through 10. The specification listings cover both dip-solder and solder cup terminations.



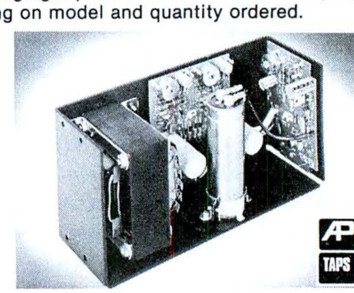
For complete MIL-S-83734A cross reference information write or phone the Garry Engineering Department directly.

For more information, contact: Harry A. Koppel, Executive Vice President, Garry Manufacturing Co., 1010 Jersey Avenue, New Brunswick, N.J. 08902; (201) 545-2424.

CIRCLE INQUIRY NO. 125

TAPS Series for Microprocessor Applications

TAPS SERIES of triple output D.C. power supplies for microprocessor and other multiple D.C. power applications are now available with a choice of four D.C. outputs and dimensions, ranging in price from \$75.90 to \$163.00, depending on model and quantity ordered.



Regulation is ±0.1% for line and load with universal A.C. Input of 115/230V ±10%, 47-63Hz. Ripple is 5mV peak to peak maximum; typically 1mV.

Operating at full output power over the range of −20°C. to +50°C., the units can operate up to 65°C. with derating.

Stability is ±0.2%; outputs exhibit no overshoots as a result of turn-off, turn-on or power failure. Transient response is less than 50 microseconds.

All three outputs on the TAPS SERIES are isolated from each other so that either positive or negative can be grounded on any output. Adjustment of output voltages is accomplished by means of a screwdriver adjust isolated wire wound potentiometers.

Temperature coefficient is 0.02%/°C. All units are rated fully with convection cooling up to 50°C. in free air. Optional 70°C. units are also available.

Units are constructed on aluminum chassis with approximately 20% more heat sink area than competitive units making higher reliability MTBF figures possible. All units may be mounted in various orientations and various optional fasteners can be provided.

Overvoltage is included in all units on the 5V outputs and foldback current limiting is standard for all three outputs.

Remote sense is also provided on the 5 Volt output on all units.

Available for delivery off-the-shelf, the TAPS SERIES provides a ready solution to many multiple D.C. voltage requirements. For further information, please contact K. Nelson or G. Mousel,

Adtech Power, Inc., 1621 S. Sinclair St., Anaheim, CA 92806, (714) 634-9211.

CIRCLE INQUIRY NO. 118

OSI Auto-Load™ Cassettes

OSI announces a full set of software available on cassette for use with any 6502 system equipped with OSI's 65V PROM monitor.

Through the use of this monitor's load command, these cassettes automatically generate a complete operating system in the computer including CRT routines, keyboard routines, cassette I/O and the program of interest. Thus, the user simply turns the computer on and types an "L" at the keyboard—the cassette does the rest!

Programs now available include: Tiny BASIC for 4K and 8K computers, 6502 Resident Assembler, an Extended Monitor, "Life," a Graphics Editor, some games and OSI's new 6502 8K BASIC by Microsoft. Prices range from $5 to $50 including manuals.

For further information, contact OSI, Ohio Instruments, 11679 Hayden St., Hiram, OH 44234.

CIRCLE INQUIRY NO. 123

Blank 8K RAM Board

Ithaca Audio announces its new blank 8K RAM board for 2102 or equivalent 1K static memory. Features include full buffering on all address and data lines, memory protect/unprotect and selectable wait states. It is available only as a blank board with documentation for $25.00. Liberal dealer and quantity discounts are available.

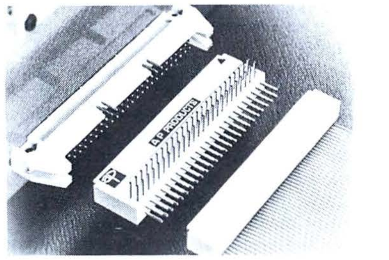
This is the only blank 8K board on the market today and has generated tremendous interest with the advanced hobbiest who has access to his own memory and does not want to pay for a kit.

For furhter information, contact: Steven Edelman, Ithaca Audio, Box 91, Ithaca, NY 14850, (607) 273-3271.

CIRCLE INQUIRY NO. 127

Intra-Connectors™

Designed for people using or designing with flat ribbon cables and standard double-row socket connectors, the Intra-Connector™ consists of a standard female double row socket connector and two sets of mating male contact pins, at right angles to each other.



Thus Intra-Connector can be used as a through-line connector, either straight or at right angles, with a redundant set of male pins to facilitate signal tracing and measurement at various points throughout flat cable systems — wherever, in fact, a connector is now installed. In this application, Intra-Connector is a valuable testing tool.

Intra-Connector can also be used to expand upon existing systems by residing as a line "tap," the full cable wide. Thus daisy chains can be built into existing systems quickly and easily. Here, Intra-Connector performs as an equivalent to the cube tap.

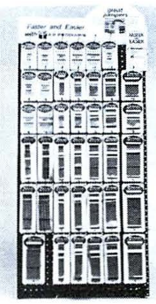
Intra-Connector is available in the five most popular flat ribbon cable line widths to work immediately with the bulk of all of today's systems: 20, 26, 34, 40 and 50 contacts (lines) wide.

Intra-Connector is available from A P Products distributors, who can be located through the company's toll-free Faster And Easier Line, (800) 321-9668. Or write A P Products, Box 110, 72 Corwin Drive, Painesville, Ohio 44077.

CIRCLE INQUIRY NO. 128

Great Jumpers

Great Jumpers are the first and only flat cable connector system to be fully pre-assembled and pre-tested at the factory. Cable strain reliefs are an integral part of the molded-on connectors. And tiny access ports at the rear of each connector permit complete line-by-line probeability, even after installation.



Great Jumpers are available in several lengths and configurations in the 5 most popular cable widths, 20, 26, 34, 40 and 50 conductors. Configurations included are industry standard double row socket connectors (2 rows of contacts on a 1/10 inch by 1/10 inch matrix), as well as card-edge and PCB industry standard connectors.

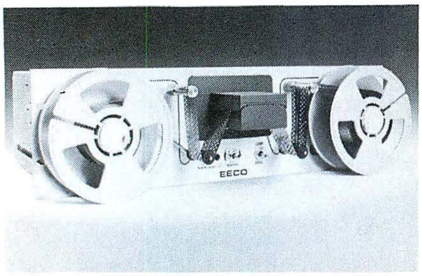
Great Jumpers are very easy to recognize. Double ended and daisy chain jumpers are bold electric pink in color. One edge of the flat cable, however, is color striped for easy assembly indexing. Single ended assemblies use standard rainbow color-coded cable.

Dealers and distributors who carry Great Jumpers and the entire A P Products Faster and Easier Line can be located through the company's toll-free Faster and Easier Line: 800-321-9668, or contact A P Products Incorporated, Box 110, 72 Corwin Drive, Painesville, Ohio 44077, (216) 354-2101.

CIRCLE INQUIRY NO. 129

Punched Tape Reader/Spooler for CNC Applications

EECO's new 2001-4 Reader/Spooler is designed for numerical control and automatic machine control applications. It reads bidirectionally at speeds up to 200 cps in step or in priority interrupt mode and searches and rewinds at 400 cps.



The EECO 2001-4 read head opens wide for easy tape loading. It is self-cleaning and will not build up static electricity. The fully proportional servo spooler system, broad shouldered sprocket and step motor drive are designed for gentle handling of tape.

EECO 2001-4 can operate in loop or spool mode. The 5½" reels can hold up to 600 feet of 2.7 mil tape. The unit can read 5, 6, 7 and 8 level tapes, up to 0.0045 inches thick, that are at least 40% opaque. Single unit price is $750 with OEM volume discounts available.

For further information contact EECO, 1441 East Chestnut, Santa Ana, California 92701 or phone "EECO Peripheral Products" (714) 835-6000.

CIRCLE INQUIRY NO. 130

"Comparison Shopping" Catalog

Computer Warehouse Store announces the availability of its 48-page catalog for personal computing enthusiasts and small systems users. It explains five different microcomputer kits and an abundance of 90-day warranteed used peripherals such as CRT terminals, keyboard/printer terminals, video monitors, tape drives, disk drives and printers. Since it is the only such catalog available in the microcomputing field, it marks the beginning of "Mail-order computers" and alleviates hardware and information inaccessibility that has caused problems for many computerists in this field.

"All About Hobby Microcomputer Systems," a special report featured in the catalog, provides pertinent information of concern to all computerists — from novice to sophisticated hacker. It tells what to look for in selecting a microcomputer system (Data width, addressing, capacity, and instruction set, for example), micro alternatives (homebrews, kits and assembled systems), basic system considerations and system versatility through expansion.

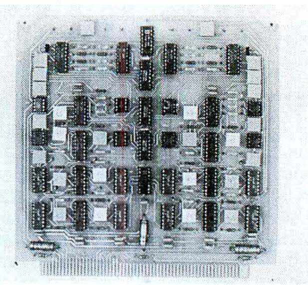
The Catalog is slated to be printed twice a year and according to Sonny Monosson, president of American Used Computer, it will offer the best available used peripherals to computerists. The ability of Computer Warehouse Store to offer this equipment is because of large volume buying and the resources and contacts of the parent company, he explained.

The catalog is available for $1 from Computer Warehouse Store, Dept. C, P.O. Box 68, Kenmore Station, Boston, Mass. 02215.

CIRCLE INQUIRY NO. 131

Zilog Z-80 MCB Compatible Programmable Gain Amplifier Card (PGA)

The Signal Laboratories, Inc. Programmable Gain Amplifier card (PGA) is a Zilog Z-80 MCB compatible accessory offering two channels of computer controlled amplification, each having both filtered and unfiltered outputs.

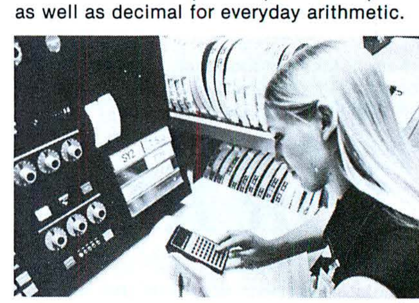


Under control of the Z-80 MCB the gain of each channel may vary from unity (0db) through 54 db (70 db optional) in 2 db increments with gain accuracies of 0.1% (0.01% optional). Similarly the Z-80 MCB may select any one of eight customer-predetermined bandwidths for each channel's filtered output. Unfiltered outputs are 3 db down at 50 KHz. The PGA is one of a family of Zilog Z-80 MCB compatible accessory cards available from Signal Laboratories, Inc., 202 N. State College Blvd., Orange, CA 92668. For information call Del Flagg or Bill Chidester at (714) 634-1533. Price for quantities under ten is $395. Available from stock.

CIRCLE INQUIRY NO. 132

Hexadecimal Calculator Helps Programmers Work with Computer Number Systems

Called the TI Programmer, it is the latest productivity tool for programmers and others who work with computers. The number bases include hexadecimal (base 16) and octal (base 8) as well as decimal for everyday arithmetic.



Since most computers use a binary number system for internal data storage and addressing, programmers and computer users are often required to convert and manipulate coded numbers in other related number bases. In the past, this required time-consuming manual calculations and the use of addition, multiplication and conversion tables.

Now users of the new TI calculator can get those answers fast by keying in the problems in the same number system used by the computer. Then the calculator performs its operations in that number system and converts results to a number system which users can interpret more rapidly.

The calculator can perform bit by bit logical operations on numbers in hexadecimal or octal. Included are AND, OR, Exclusive OR and SHIFT operations.

Users will also find the calculator useful as a regular day-to-day, four-function machine in the decimal base. The unique combination of functions make it an excellent tool to handle the bulk of a programmer's personal and professional requirements. Its speed in all number bases is essentially instantaneous.

A constant mode can be used for all kinds of repeated arithmetic and logical operations. Memory features include store, recall and sum.

Other features include an eight digit LED display, rechargeable battery, vinyl carrying case and AC adapter/charger.

The calculator is being test marketed initially on a direct-mail basis from Texas Instruments. It sells for $49.95.

For further information contact: Texas Instruments Incorporated, Inquiry Service, P.O. Box 5012, M/S 84 (Attn: TIP), Dallas, TX 75222.

CIRCLE INQUIRY NO. 133

OSI Auto-Load™ Cassettes

OSI announces a full set of software available on cassette for use with any 6502 system equipped with OSI's 65V PROM monitor.

Through the use of this monitor's load command, these cassettes *automatically* generate a complete operating system in the computer including CRT routines, keyboard routines, cassette I/O and the program of interest. Thus, the user simply turns the computer on and types an "L" at the keyboard—the cassette does the rest!

Programs now available include: Tiny BASIC for 4K and 8K computers, 6502 Resident Assembler, an Extended Monitor, "Life," a Graphics Editor, some games and OSI's new 6502 8K BASIC by Microsoft. Prices range from $5 to $50 including manuals.

For further information, contact OSI, Ohio Instruments, 11679 Hayden St., Hiram, OH 44234.

CIRCLE INQUIRY NO. 134

The Mainframe

The Mainframe is a foundation unit for a microcomputer system consisting of a heavy duty aluminum cabinet, finished in TEI blue and vented for most efficient airflow.

The power supply consists of a constant voltage transformer providing brownout protection and showing a very high immunity of input to output noise, better than 100 db. The power supply is designed to meet UL specifications and is complete with primary and secondary voltage fuse protection. The power supply is rated at 17 amps at 8 volts and at 2 amps plus or minus 16 volts.

The mother board is a 12-slot S-100 bus system furnished with all edge connectors inserted, soldered and checked out. No soldering is required. Fully compatible with all S-100 bus type PC boards.

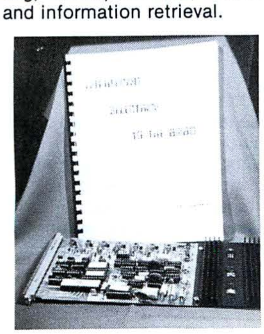
The front panel includes an indicating AC switch and a reset switch but the unit is also designed to accept the TEI "Virtual Operating Console" front panel which will soon be available.

A 115 CFM muffin fan with a commercial grade washable filter is furnished to provide a clean airflow. All wiring is precut and prelugged for ease of assembly. Supplied either as a kit or assembled, specify Model MCS-112-K for the kit or Model MCS-112-A for the assembled unit. For more information contact Bill R. Tatroe, CMC MARKETING CORP., 7231 Fondren Road, Houston, Texas 77036 or call (713) 774-9526.

CIRCLE INQUIRY NO. 135

Interfacing Selectrics

Explore the use of a Selectric as a microcomputer terminal for application areas as word processing, correspondence, newsletter composing and information retrieval.



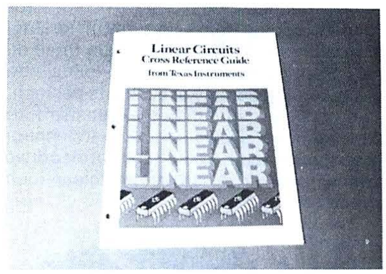
Electronic interface kits are available for *output only*. Standard ASCII serial RS-232C input. Includes fourteen solenoid drivers for 24 volts — you provide the solenoids and mechanism. Only $325 in kit form w/o power supply. Power supply versions available. Shipment four weeks ARO. Manual only for $12.

For brochure or further information, send self-addressed stamped envelope to Center For the Study of the Future, 4110 N.E. Alameda, Portland, OR 97212, (503) 282-5835.

CIRCLE INQUIRY NO. 136

Linear Circuits Cross Reference Guide

A linear IC cross reference guide is available free from Texas Instruments. It lists TI's direct replacement ICs for linear circuits produced by five other manufacturers.



Direct replacement is based on electrical and mechanical characteristics as shown in current published data. Interchangeability in particular applications is not guaranteed.

The guide includes both control and interface circuits produced by Fairchild, Motorola, National, Raytheon and Signetics.

For further information, contact: Texas Instruments Incorporated, Inquiry Answering Service, P.O. Box 5012, M/S 51 (Attn: Bulletin CB-245), Dallas, Texas 75222.

CIRCLE INQUIRY NO. 137

Disc Interpreter for 8080s

Binary Systems Corporation today introduced DISK BASIC ETC, a disc-accessing, extended version of BASIC ETC.

DISK BASIC ETC is a general purpose program suitable for business and scientific applications, as well as hobbyist game programming.

The sector-based DOS, which works with the iCOM floppy disc controller, makes available up to three memory buffer files to the user.

The disc software includes six file manipulation commands plus SAVE, LOAD and two special integer functions helpful in keeping track of files.

DISK BASIC ETC uses the lower 12 KB of memory plus 1 KB of scratchpad. User input and output routines, and stack and memory end values are specified in a user's manual.

DISK BASIC ETC is supplied on a certified, 5¼ inch minifloppy disc, or on a certified, 8 inch regular floppy, along with a comprehensive user's manual. The price is $50.00; the manual sells for $10.00 separately.

DISK BASIC ETC may be ordered from the Micro Store, 634 S. Central Expressway, Richardson, TX 75080. Orders should include a check or money order for the price of the item. The Micro Store is the retail affiliate of Richardson-based Binary Systems,Inc.

CIRCLE INQUIRY NO. 138

Motorola HEP Catalog

Motorola's HEP semiconductors are offered as replacements for over 60,000 different discrete devices and ICs. Intended for, but not limited to, the hobbyist, experimenter and the professional service technician/dealer, the HEP products are specified to meet or exceed the important mechanical and electrical characteristics of the replaced device. In many cases, one HEP device will be recommended as the replacement for a large number of components. Because of this one-to-many ratio, the HEP device specifications will often exceed some of the specifications of a number of the replaced devices. For example, a HEP device that replaces a series of transistors whose individual BV_{CEO}'s range from 20V to 80V would have a BV_{CEO} spec. of 80V.

The latest edition of the Motorola HEP Semiconductor Cross Reference Guide and Catalog will be available in May, 1977. This 184 page book describes discrete silicon and germanium power transistors, thyristors, small-signal FETs and bipolar transistors, C.B. RF power transistors, zeners, rectifiers and opto-electronic devices. Digital ICs, in RTL, HTL, DTL, TTL and CMOS technologies, are also included as well as linear bipolar radio/television ICs, voltage regulators, op-amps, etc.

One hundred and ninety-eight new products have been added to the Catalog; 104 are newly offered TTL functions. Industry popular TO-220 packaged components are also included. A single chip, 3½ digit DVM IC, that utilizes CMOS technology to provide both linear and digital circuit functions, is also described. The Catalog also describes the Educator II Microcomputer and Power Supply Kits. The Microcomputer is based on the popular M6800 technology.

The unit price of this new Motorola HEP Semiconductor Cross Reference Guide and Catalog is $2.00; availability: from HEP/MRO Operations Headquarters and HEP distributors. For further information, contact: Motorola HEP/MRO National Sales Manager, 705 West 22nd Street, Tempe, Arizona 85282, (602) 244-3208.

CIRCLE INQUIRY NO. 139

Reader/Spooler Designed for Machine Control Applications

EECO 2001-5, with 7½" spools and a capacity of up to 1200' of tape, is designed for numerical control and automatic machine control applications. It reads bidirectionally at 200 cps in spooler or loop mode and in either step or priority interrupt mode. It searches and rewinds at 400 cps. EECO 2001-5 handles all common standard widths, types and levels of punched tape having up to 60% transparency.

The read head is self cleaning and opens wide for easy tape loading. It is designed to reduce read errors due to tape punched out-of-tolerance. The wide shouldered sprocket and step motor drive combine with the fully proportional servo controls to assure gentle tape handling. Single unit price is $795. with OEM volume discounts available.

For further information, contact EECO, 1441 East Chestnut Avenue, Santa Ana, California 92701 or phone (714) 835-6000 and ask for "Peripheral Products."

CIRCLE INQUIRY NO. 140

Disc Drive Stores Up to 70M Bytes at 1M Bytes/Sec

A new line of fixed-cartridge, moving-head disc drives, from Kennedy Company stores up to 70M bytes of data at rates of 1M bytes per second, about 25 to 50 percent more storage at 42 percent faster data rate than similarly priced competitive units. Designated the Series 5300, the new Kennedy drives have unformatted capacities ranging from 14M bytes in the single-disc version up to 70M bytes in the three disc model. Each surface has two 350-tpi cylinders with a recording density of 6000 bits per inch. A sealed enclosure eliminates expensive filters and blowers, yet allows operation in locations previously considered unsuitable for disc drives. In a sense, each drive has its own "clean-room" environment.

Using the "Winchester" technique, a dual-head carriage is driven in an arc by a d'Arsonval-type actuator which rapidly and accurately positions the heads without complicated mechanisms such as lead screws or linear motors. Head positioning is controlled by pre-recorded servo-tracks on the bottom of one disc, eliminating mechanical encoder plates.

Power supply and all electronics are included in a single, easily-serviced assembly. Standard power requirements are 120V at 60Hz with 230V @ 50Hz optional.

The drives measure 19 inches wide by 7 inches high by 22 inches deep. (48.26 cm by 17.78 cm by 55.88 cm). Weight is 45 lbs. (20.41kg).

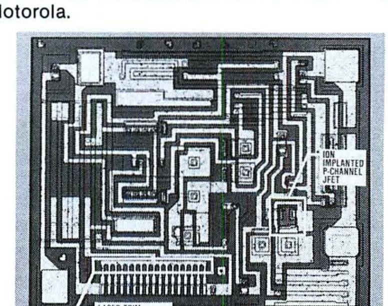
Series 5300 prices range from $2500 to $4000 depending on capacity and quantity ordered. Delivery is 90 days after receipt of order.

For further information, contact: Kennedy Co., 540 West Woodbury Road, Altadena, California 91001, (213) 798-0953.

CIRCLE INQUIRY NO. 141

Precision Voltage Reference for Instrumentation

A stable 2.5 Volt reference source, type number MC1403/1503 has been introduced by Motorola.



Designed for critical instrumentation and D-A converter applications, the low-cost monolithic circuit features a maximum output voltage variation of only 1% (± 25mV) and a typical temperature coefficient of ($\Delta Vo/°\Delta T$) pf 10 ppm/°C.

Laser trimming of resistive networks as a routine process during normal manufacture provides a high yield to a very tight tolerance specification. The laser trimming process adds to the probing time and requires a small amount of additional real estate (compared with non trimmed chips) but effectively increases the tight-tolerance yield to the point that the small cost increase is swamped by the overall cost reductions made possible, compared with device selection to a given spec.

This chip also represents the first utilization of a P-channel J-FET in a linear integrated circuit at Motorola (a relatively new production technology). Ion implantation is the technology responsible for this capability.

Other important circuit specifications include:

Line Regulation = 3mV (max) at input voltage from 4.5 to 15 V.
4.5mV (max) at input voltage from 15 to 40 V.

Load Regulation = 10mV (max) at output currents from 1 to 11mA.

For further information, contact Motorola Semiconductor Products, Inc., P.O. Box 20912, Phoenix, AZ 85036, (602) 244-6900.

CIRCLE INQUIRY NO. 142

TAPS Series for Microprocessor Applications

TAPS SERIES of triple output D.C. power supplies for microprocessor and other multiple D.C. power applications are now available with a choice of four D.C. outputs and dimensions, ranging in price from $75.90 to $163.00, depending on model and quantity ordered.

Regulation is ±0.1% for line and load with universal A.C. Input of 115/230V ±10%, 47-63Hz. Ripple is 5mV peak to peak maximum; typically 1mV.

Operating at full output power over the range of −20°C. to +50°C., the units can operate up to 65°C. with derating.

Stability is ±0.2%; outputs exhibit no overshoots as a result of turn-off, turn-on or power failure. Transient response is less than 50 microseconds.

All three outputs on the TAPS SERIES are isolated from each other so that either positive or negative can be grounded on any output. Adjustment of output voltages is accomplished by means of a screwdriver adjust isolated wire wound potentiometers.

Temperature coefficient is 0.02%/°C. All units are rated fully with convection cooling up to 50°C. in free air. Optional 70°C. units are also available.

Units are constructed on aluminum chassis with approximately 20% more heat sink area than competitive units making higher reliability MTBF figures possible. All units may be mounted in various orientations and various optional fasteners can be provided.

Overvoltage is included in all units on the 5V outputs and foldback current limiting is standard for all three outputs.

Remote sense is also provided on the 5 Volt output on all units.

Available for delivery off-the-shelf, the TAPS SERIES provides a ready solution to many multiple D.C. voltage requirements. For further information, please contact K. Nelson or G. Mousel, Adtech Power, Inc., 1621 S. Sinclair St., Anaheim, CA 92806, (714) 634-9211.

CIRCLE INQUIRY NO. 160

Model 200 MINIDRIVE™

Microperipheral

The media used by the Qantex MINIDRIVE™ is the DC100A cartridge developed by 3M. The DC100A is a miniaturized version of the well-known and widely used DC300A data cartridge. The DC100A data cartridge is used in all recently introduced Hewlett-Packard Desk Top Calculators and Intelligent Terminals. The DC100A is essentially the same as the DC300A but reduced in size to 2.41 by 3.18 by 0.47 inches. The weight is only 2 ounces, thus perfect for mailing.

The Qantex MINIDRIVE™ is super compact, 3 inches high by 4 inches deep by 4.125 inches wide and weighs only one pound. It features design simplicity including an aluminum base place for mechanical integrity with automatic and positive cartridge positioning. The servo loop includes a solid state optical tachometer for precise speed control of the low inertia DC motor. The Model 200 includes a completely solid state Tape Mark Sensor for detection of beginning of tape and end of tape.

The Model 200 MINIDRIVE™ is available with 800 bpi or optional 1600 bpi packing density resulting in a transfer rate of 24,000 or 48,000 bits per second at 30 inches per second. The storage capacity is from 168,000 bytes for a MINIDRIVE™ with a single track head and 800 bpi packing density to 772,000 bytes of unformatted data for a MINIDRIVE™ with a dual track head and 1600 bpi packing density.

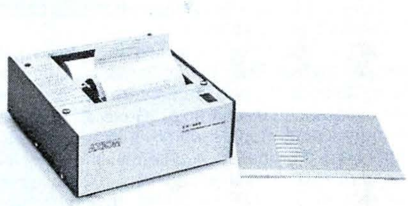
The MINIDRIVE™ has only one motor as opposed to two or more for Floppys and cassettes, thus resulting in an increased MTBF (Mean Time Between Failure). The MINIDRIVE™ is capable of operating in severe environments since aside from the motor, there is virtually no other mechanism.

For further information contact: Leon Malmed, Sales Manager, Qantex Division of North Atlantic Industries, 200 Terminal Drive, Plainview, NY 11803; (516) 681-8350.

CIRCLE INQUIRY NO. 143

$655 Line Printer has 80-Column Format and Speed of 160 Characters Per Second

An ultra-compact 80-column line printer which operates at 160 characters per second (14 times faster than a Teletype), and is priced at $655, will be shown for the first time at NCC-77 by the Axiom Corporation.



The Axiom EX-800, is a complete, stand-alone printer which includes a case, power supply, ASCII interface, character generator and paper roll holder. It's ready to plug into almost any system. An RS232C serial interface, with a switch to provide plug compatibility with Centronics or Tally input connectors, is available for $85.

Standard features, many of which are not available on other printers regardless of cost, include infra-red low paper detector, bell, 96 character ASCII set, programmable character size, built-in self tester and multi-line asynchronous input buffer.

The heart of the EX-800 is a single printed circuit card, containing a custom LSI chip made by Intel to Axiom specifications, which controls all printer functions and can be removed without desoldering. The simple non-impact print mechanism is virtually maintenance free. The MTBF is said to be many times greater than impact printers.

The EX-800 prints on a five inch wide electrosensitive paper, using a proven technique which combines mechanical simplicity with high speed to achieve extremely cost effective hard copy. The printout is formed by a high current for about one microsecond from the fine wires of the printhead to the surface of the paper. The aluminum is removed almost instantaneously, exposing a layer of black ink which is seen as a dot matrix forming the printout. the permanence of the hardcopy is archival, since once the aluminum coating has been removed, there is no way to put it back. Thus, the shelf-life of the paper is indefinite and print quality is unaffected by direct sunlight or moisture and does not age. The high-contrast printout makes excellent photocopies. Also, electrosensitive paper is inexpensive and is readily available from many domestic sources.

The Axiom EX800P (with parallel ASCII interface) is priced at $655 in unit quantities. The EX-800S (with RS232C serial interface) is $740. OEM discounts are available. Delivery is 30 days from receipt of invoice.

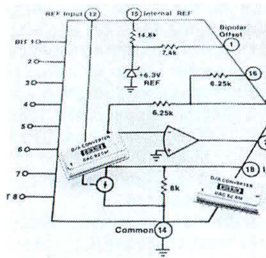
For further information contact Simon Harrison, Vice President of Marketing, Axiom Corporation, 5932 San Fernando Road, Glendale, California 91202. (213) 245-9244.

CIRCLE INQUIRY NO. 144

CIRCLE INQUIRY NO. 88

8-Bit D/A Delivers ±1 LSB Accuracy at Room Temp with No External Adjustments

Burr-Brown's new DAC 82 is a self-contained multiplying D/A that provides ±1 LSB accuracy at room temperature with no external adjustments, and ±1/2 LSB linearity over the full temperature range.



Complete with internal reference, scaling resistors and an output amplifier, the DAC82 is easy to use in normal or 2-quandrant mulitplying applications, with either voltage or current output. In fact, it's the first 8-bit DAC that can be used with either an internal reference for normal operation or with an external reference for multiplying applications. Furthermore, the reference input is a summing junction, which allows the designer to use any positive value reference voltage with an appropriate input resistor.

The DAC82 is available in two versions, both hermetically sealed in metal packages, but priced in the same range as similar devices in glass packages.

The BM version has a specification temperature range of −25°C to +85°C. The SM version covers the full military temperature range of −55°C to +125°C. All important parameters are tested over that range.

Other specifications common to both units include: Voltage output settling times (±0.2% of FSR) of 2.0 msec; current output settling time of 250 nsec; selectable voltage output ranges; and gain drift better than ±50 ppm/°C over the entire temperature range.

Prices for the DAC82 BM range from $29.00 (1-9) to $19.25 (100-249). The DAC82 SM starts at $38.00 (1-9) and goes to $26.25 (100-249). Delivery is from stock.

For more information, contact Joe Santen, Product Manager, Burr-Brown, International Airport Industrial Park, Tucson, Arizona 85734. Phone (602) 294-1431.

CIRCLE INQUIRY NO. 145

Precision Voltage Reference for Instrumentation

A stable 2.5 Volt reference source, type number MC1403/1503 has been introduced by Motorola.

Designed for critical instrumentation and D-A converter applications, the low-cost monolithic circuit features a maximum output voltage variation of only 1% (±25mV) and a typical temperature coefficient of (ΔVo/°ΔT) pf 10 ppm/°C.

Laser trimming of resistive networks as a routine process during normal manufacture provides a high yield to a very tight tolerance specification. The laser trimming process adds to the probing time and requires a small amount of additional real estate (compared with non trimmed chips) but effectively increases the tight-tolerance yield to the point that the small cost increase is swamped by the overall cost reductions made possible, compared with device selection to a given spec.

This chip also represents the first utilization of a P-channel J-FET in a linear integrated circuit at Motorola (a relatively new production technology). Ion implantation is the technology responsible for this capability.

Other important circuit specifications include:

Line Regulation = 3mV (max) at input voltage from 4.5 to 15 V.
4.5mV (max) at input voltage from 15 to 40 V.

Load Regulation = 10mV (max) at output currents from 1 to 11mA.

For further information, contact Motorola Semiconductor Products, Inc., P.O. Box 20912, Phoenix, AZ 85036, (602) 244-6900.

CIRCLE INQUIRY NO. 146

Blank 8K RAM Board

Ithaca Audio announces its new blank 8K RAM board for 2102 or equivalent 1K static memory. Features include full buffering on all address and data lines, memory protect/unprotect and selectable wait states. It is available only as a blank board with documentation for $25.00. Liberal dealer and quantity discounts are available.

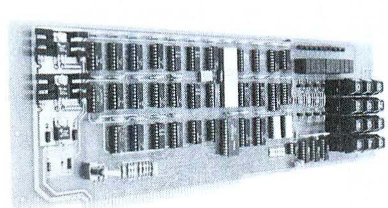
This is the only blank 8K board on the market today and has generated tremendous interest with the advanced hobbiest who has access to his own memory and does not want to pay for a kit.

For furhter information, contact: Steven Edelman, Ithaca Audio, Box 91, Ithaca, NY 14850, (607) 273-3271.

CIRCLE INQUIRY NO. 147

A CPU Board/Front Panel with Mini-Computer Capabilities

Fully compatible with the S-100 buss, this single board can replace the CPU board and front panel of existing microcomputer systems to achieve mini-computer performance; or form the basis of a custom system, using S-100 buss peripherals and a mother board.



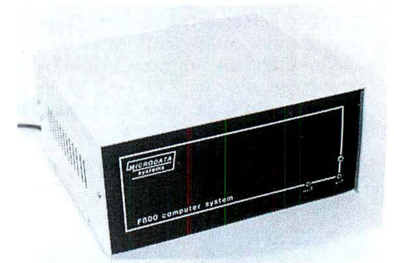
Two exclusive operating modes allow the user to work on a program while it's running: "Slow Step"™ steps through the program at a rate variable from 1 to 65,000 steps per minute; "Control Halt"™ prevents the 8080A CPU from shutting off after a HALT instruction. While in this state, registers, memory, and I/O locations may be examined and altered at the front panel. A 12 pad keyboard and ten 7 segment readouts simplify data loading and examination.

Extensive buffering assures unambiguous data transfer; low power Schottky support ICs reduce power consumption; onboard regulation relaxes power requirements. Available in both kit form ($250) and assembled/tested/warranted ($325), by mail (Morrow's Micro-Stuff, Box 6194, Albany, CA 94706) or from many computer stores. Includes complete documentation.

CIRCLE INQUIRY NO. 148

F800 Microcomputer System Complete with 8K Memory and 5K BASIC

MICRODATA Systems F800 Computer is based upon the Mostek F8 Microprocessing unit (MPU) and its matching support devices.



The F800 system comes with: a) CPU board populated with 2MHz crystal clocked F8 MPU, 1K ROM system monitor, static memory interface with 65K addressing range and 128 x 8 byte scratch pad RAM. All address, data lines and outputs are fully buffered, Data bus lines are bidirectional. b) 8K bytes static RAM memory. c) H.D. power supply. d) serial interface port 100/300 baud RS-232 or 20 MA loop, dip switch selectable. e) three parallel I/O ports (8 bit bi-directional TTL). f) 12 slot mother board. g) attractive durable commercial cabinet. h) extensive programming, data & system manuals. Also included with the system is the F800 5K basic interpreter & users manual. The F800 system is offered as a kit or completely assembled & tested.

Some of the outstanding features of the F800 system are: Ease of assembly due to its inherent modular packaging and accessibility. (Average assy. time 12 Hrs.)

Will interface easily (without additional boards) to most OEM peripherals i.e. digital cassettes, CRT terminals, teletypes, printers etc.

Heavy duty power supply 110-125 V 50/60 Hz primary, secondaries +5 V @ 15 AMPS and ±12 V @ 2 AMPS with local regulation. More than enough power for a fully expanded system.

Introductory price for the F800 system is $499.00 kit (includes all IC sockets), $699 assembled & tested. Additional 4K memory boards including sockets are $129.00 kit form and $199.00 assembled & tested.

Delivery is quoted at 30 days or less after receipt of order. For further information, contact: MICRODATA Systems, 2 Mack Rd. #101, Woburn, Mass. 01801. Dealer inquiries invited.

CIRCLE INQUIRY NO. 149

New Subsystem Gets Microcomputers Working Faster

Designated Subsystem B, the package is offered in three different modules differing only by amount of memory offered. Users of Subsystem B will find that all the major system elements necessary to get such computers as Altair, Imsai and Comemco Z-2 on the air are provided. Subsystem B includes RAM and PROM memory, parallel, serial, cassette and video display interfaces and software. The software includes a bootstrap loader program to load CUTS 1200 BAUD cassette tapes.

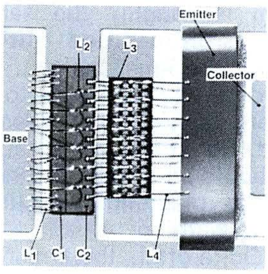
Each of the three packages includes Total Memory (bytes); Display I/O; Parallel, Serial I/O; Tape Cassette I/O and Memory (KRA), plus the new Processor Technology General Purpose Memory (GPM) module which is included at no extra cost. Purchased separately, the GPM is priced at $129. The GPM provides 1024 bytes of low power static RAM, 2048 bytes of preprogrammed ROM or EPROM and space for 8192 bytes of ROM or 2708 type EPROM in addition. The GPM can be used with the new ROM version of the firm's ALS-8 Editor/Assembler software package. Price of the ALS-8/ROM chip set is $159.

Subsystem B is availble from Processor Technology dealers throughout the U.S. and Canada or may be ordered directly from the firm. For prices and more information, please address Processor Technology Corporation, 6200 Hollis Street, Emeryville, CA 94608. Phone (415) 652-8080.

CIRCLE INQUIRY NO. 150

High Technology RF Transistors Increase Output Power at UHF

A series of new RF power transistors that extends RF power output capabilities to 80 Watts in the 100 to 500 megahertz range has been introduced by Motorola.



The devices are designed for broadband operation as Class A, AB, B and C transmitter amplifiers in UHF communications equipment operating form a 12-28 Volt power supply. One primary application is expected to be in Military Aircraft Radios.

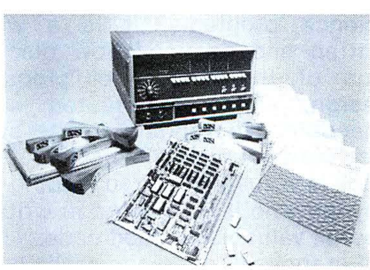
To achieve the reliability required for military applications, an all-gold metallization system is employed for all devices. Gold is used for the top metal of the transistor, for the associated MOS capacitors, for the bonding wires, as well as for package plating. The reliability advantage achieved results from the elimination of "aluminum migration" and corrosion due to contact of dissimilar metals.

The new devices are available from OEM stock and from Motorola distributors. For pertinent statistics, prices, and further information, contact Motorola Semiconductor Products, Inc., P.O. Box 20912, Phoenix, AZ 85036, (602) 244-6900.

CIRCLE INQUIRY NO. 151

IMP-16L Microcomputer Gives 16 Megabit/Sec DMA Transfer

A 16-bit microcomputer, developed by the Microcomputer Systems group of National Semiconductor Corporation, has a high-speed asynchronous bus and data controller that allows direct-memory-access (DMA) data transfers at rates to 16 megabits per second. Designated the IMP-16L, the fully assembled unit includes an IMP-16 CPU board with DMA control, 4K by 16 bits of random-access memory expandable to 64K, a standard TTY interface module and complete program control panel. Optional cards provide interface for a Centronics 306 printer, a Documation 300 card reader and a National IMP-16/805 programmed-read-only-memory (PROM) programmer card.



The programmers panel has an array of data switches, data and address indicators, and function switches. Through it, the operator may address, load and examine memory controls or CPU registers.

The microcomputer has 60 general-purpose instructions which include time-saving single-word commands such as multipily, divide, double precision add, double-precision subtract and many bit or byte oriented instructions. It also accommodates either the Arithmetic or POWRI/O control read-only memory (CROM) devices. The Arithmetic CROM has ten addition instructions that speed calculations involving high-accuracy fractional data and floating point numbers. The POWRI/O CROM, with eleven instructions, provides block-transfer and peripheral I/O commands that allow programmed data transfers up to 97K words per second. Combining the DMA capability with the special instructions gives the IMP-16L the power to handle data processing tasks traditionally in the minicomputer domain.

The IMP-16L has four general-purpose registers and a 16 work last-in-first-out stack. Input/output lines include eight general-purpose flags, one general interrupt, one vectored interrupt and four general-purpose jump condition inputs.

With a 1.4 msec microcycle time, the IMP-16L has typical register-to-register addition times of 4.9 msec and memory-to-memory addition times of 8.4 msec. A DMA transfer requires 1.05 msec.

Software support includes CPU, memory and peripheral diagnostic routines; software DEBUG, resident assembler; IMP-16 to PACE or SC/MP cross assemblers; absolute linking loaders; and an IMP/FORTRAN cross assembler.

The 12 inch high by 17 inch wide by 24 inch long IMP-16L microcomputer has twelve connectors for CPU, memory and interface cards. For expansion, additional six-connector card cages may be installed. Required input power is 105V to 125V at 60Hz; 220V at 50Hz is optional.

The IMP-16L can be ordered directly from National Semiconductor Corporation; 2900 Semiconductor Drive, Santa Clara, CA 95051 or from local distributors. Unit prices range from $825.00 up depending on memory size and options. Quantity discounts are available. Delivery is from stock to three weeks ARO.

CIRCLE INQUIRY NO. 152

Book Review

TECHNIQUES OF PROGRAM STRUCTURE AND DESIGN

by Edward Yourdon.
Prentice-Hall, Inc., 1975.
364 pages. $16.95.
***Review by
Judy Scolney Robertson and
Larry Robertson***

Techniques of Program Structure and Design is a truly outstanding introduction to the concept of structured programming. This book is recommended for the novice programmer as well as the experienced professional. Even the home computer enthusiast can benefit from following the principles set forth in this book.

Yourdon begins this account with a preliminary look at what makes a good programmer. He then goes on to discuss top-down programming, modular programming and structured programming. His advice on debugging, antidebugging and testing concepts, if followed, can save many hours and much irritation. This is especially true for assembler language programs. Yourdon provides a set of rules or guidelines for programming which on the surface appear to take more memory, run more slowly and take longer to use than the usual "quick and dirty" programming method we've all come to know and love so well. However, based on our experience, following these rules will often result in a program that may even take less core (you won't require as many "screwball patches" to get it going), is easier and faster to debug, and is infinitely easier to modify in the future.

The author strictly emphasizes the need for thoroughly commenting programs. And since we've found from our own experience that we have on at least one occasion thrown away pieces of our own code and couldn't understand when it came back to us some months later, we could not help but agree. Of all programs, those written for the home computer can be particularly undecipherable unless the recommended programming style and documentation are employed. The author admonishes, "Only a fool would venture into an unknown forest without leaving trailmarkers behind. Writing an uncommented program is roughly the same as crawling blindfolded into the jungles of the Amazon."

Yourdon has answers to every argument against his prescribed method. For those who feel a program should be written and installed with little planning, he cites the following warning:

> ". . . Quite often, the junior programmer will argue that he is writing a 'quick and dirty' program, one that he doesn't intend to keep around for any length of time. While this is sometimes true, it is nevertheless like an architect telling his client that the building he is designing is not intended to be permanent, but rather just a 'quick and dirty' edifice. This analogy is not quite as extreme as it sounds: a number of shoddy wooden barracks and Quonset huts were erected during World War II and are still being used, much to the irritation of the present inhabitants."

Only one point in this book (as our readers will immediately recognize) is blatantly untrue:

> ". . . *As a programmer, you will always be working for an employer.* Unless you are very rich and very eccentric, you will not enjoy the luxury of having a computer in your own home. . . ."

Aside from this gross oversight on the author's part, there is little, if anything, we can find with which to disagree in the book.

Techniques of Program Structure and Design is used as a text in many data processing and computer science programs. It is a well-written and easy-to-follow discussion of the subject of program design, amply punctuated with anecdotes appropriate to the subject matter under discussion. This book is virtually required reading for anyone who is interested in writing useful, valuable or good code.

For those of our readers who have no desire to write easily understood nor modified code, may you spend the next several lifetimes trying to understand and debug the program you designed and produced, but didn't comment, six months ago.

THE SHOESTRING, START-AT-HOME, COMPUTER BUSINESS HANDBOOK:
FROM THE GARAGE, BASEMENT, BEDROOM OR CLOSET FOR THE ASPIRING COMPUTREPRENEUR

by George Alan.
Datasearch, Inc., 1977.
Paperback, 113 pages. $12.00.

Review by
Judy Scolney Robertson and Larry Robertson

The Shoestring, Start-at-Home Computer Business Handbook is a collection of suggestions and advice for the potential moonlighter or independent computer businessman. Areas as diverse as head hunting and disc and tape cleaning are covered, as are several other opportunities to utilize such skills as programming, maintenance and writing. *The Handbook* is not an easy book to read. It is poorly edited as far as spelling, punctuation and grammar are concerned. The writing style varies from stream of consciousness to hard sell, making much use of the short, choppy sentences the author advocates for writing operations manuals.

Alan's orientation is well defined in the section on "The Self-Publishing Writer." He advises the aspiring author to find a subject which will appeal to a wide-spread audience and to prepare his materials in a low-budget operation, utilizing the local offset printing shop and doing his own marketing. However, he ends the section on the following note:

> "If this work raises your eyebrows, write to us.
>
> "If you have a completed product but need a distribution outlet, we can buy from you wholesale and sell to our market base.
>
> "Or if you want to go it all on your own, we can steer you to a wealth of information in the way of books, periodicals, and home study courses on how to get started in this field."

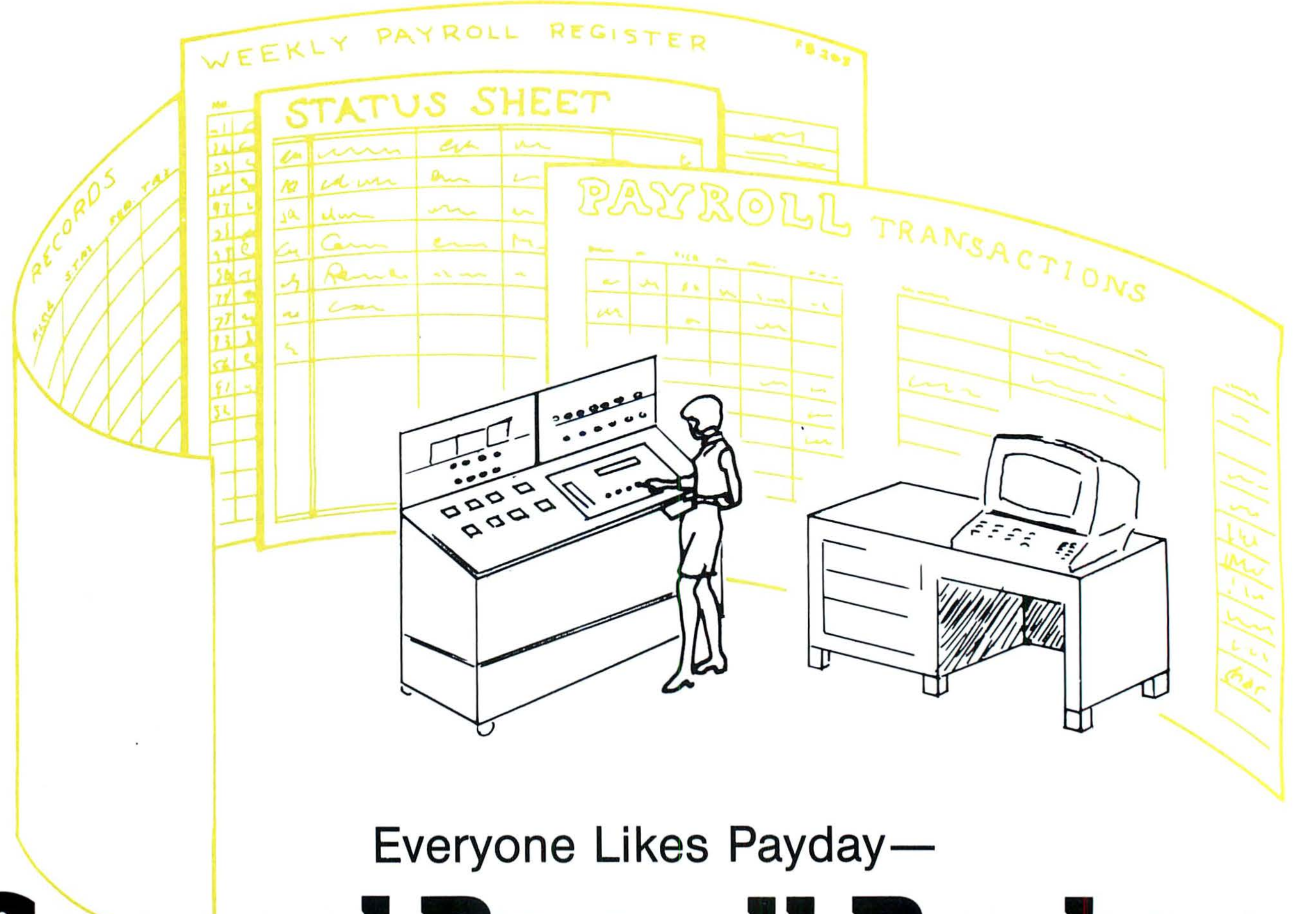
This strikes us as somewhat of a contradiction to the warning "When you're dependent on others for the basic functioning of your business in the early stages, you're one step closer to boarding up the doors when the chips are down . . ."

There's a fair amount of good advice in *The Handbook* but that advice is hard to find. The book is redundant when referring to the intuitively obvious, and casually glosses over the information that the aspiring entrepreneur needs to have. The most valuable datum in this booklet is the list of significant magazines for the computer industry. One notable omission is the absence of a listing for INTERFACE AGE in the section on "Computers in the Home — the Coming Avalanche." This oversight is somewhat mitigated by the inclusion of this publication in the list of "major industry publications" in the introduction.

Alan discusses the ethics of moonlighting and provides a reasonable set of guidelines for dealing with clients in an "up-front" manner. He also gives some good pointers for the person embarking on the "double life" of the moonlighter. Interestingly, he comes off sounding as though the independent business venture is the quick road to enlightenment or some new form of therapy.

The Handbook could stand a fair amount of editing before its next printing. A thorough job of proofreading alone would certainly improve its readability.

The Shoestring, Start-at-Home, Computer Business Handbook is available by mail from Datasearch, Inc., 730 Waukegan Road, Suite 108K, Deerfield, IL 60015. Datasearch accepts BankAmericard and Master Charge, and promises a money back guarantee of which we would have seriously considered taking advantage, were this not a complimentary copy.



Everyone Likes Payday—

General Payroll Package

by Bud Shamburger, WB5NXJ

FOREWORD

This software article is the first of a series of program features on business application programs by Bud Shamburger. This first article covers a Motel Payroll Software Package developed by Bud for his 78-unit Ramada Inn located in Arkansas.

Bud has also developed a general ledger package which includes:

- BALANCE SHEET AND OPERATING STATEMENT
- MONTHLY AND YTD BUDGET COMPARISONS
- BALANCING MONTH BANK STATEMENTS
- YEAR TO YEAR INCOME AND EXPENSE COMPARISONS
- AVERAGE DAILY ROOM RATES MONTHLY AND YTD
- OCCUPANCY RATES MONTHLY AND YTD
- CASH FLOW ANALYSIS
- STATISTICAL REPORT MONTHLY AND YTD SHOWING ALL INCOME AND EXPENSE ITEM AS A PERCENTAGE OF OCCUPIED ROOMS AND AVAILABLE ROOMS
- SPECIAL SORT PROGRAMS WHICH REARRANGE THE DATA FILES TO PRODUCE THE ABOVE REPORTS

The General Ledger Software Package will be the subject of Bud's second article on business applications to be published in INTERFACE AGE.

In addition to the General Ledger Package, Bud has an In-house Room Reservations Software Package which contains the features below:

- REVOLVING SIX MONTHS RESERVATIONS ON LINE AT ALL TIMES
- RANDOM ACCESS TO ANY DAY WITHIN THE SIX MONTHS IN LESS THAN 5 SECONDS
- THE ABILITY TO BOOK 81 ROOMS WITH ONLY ONE ENTRY
- THE ABILITY TO CANCEL 81 ROOMS WITH ONLY ONE ENTRY
- THE ABILITY TO DISPLAY ALL ROOMS IN THE INN ON THE TERMINAL FOR ANY GIVEN DAY IN THE SIX MONTHS PERIOD WITH ONLY ONE ENTRY.
- THE ABILITY TO PRINT THE ROOM STATUS FOR ANY GIVEN SEVEN DAY PERIOD WITHIN THE SIX MONTH PERIOD WITH TOTALS BY ROOM CLASS AND STATUS (BOOKED OR OPEN)
- THE ABILITY TO SEARCH ANY THIRTY DAY PERIOD WITHIN THE SIX MONTH PERIOD FOR A GIVEN GUEST NAME
- DAILY PRINT OUT OF ROOM RESERVATIONS FOR THAT DAY

The In-house Room Reservations Software Package will be the subject of Bud's third article on business applications to be published in INTERFACE AGE.

Bud is currently working on an Accounts Receivable Package and a Front Desk Clerk-Night Auditor Package (for motels) which will be published in INTERFACE AGE as the fourth article in this series. *—S.Ed.*

INTRODUCTION

Everyone likes payday, right! Well, not quite. That bookkeeper or payroll clerk who has to look up all those deductions in table after table, compute the FICA, keep track of other deductions, post the figures to everyone's payroll records, keep track of hours worked and then write the payroll register and paychecks, don't quite see payday in the same way as the rest of us.

It just happens that at my place of business, my wife is that payroll clerk, or rather used to be! Now, my Altair™ takes care of all those payroll drudgeries and at last everyone looks forward to payday. In my case, it also helps make the next addition to my Altair™ a little more palatable at

home, not to mention the cost savings at work and the more accurate and efficient payroll system.

If you've been looking for ways to put your micro to work at the old store, or to impress the boss with some fancy micro work that is sure to please, here's a good place to start.

HARDWARE CONFIGURATION

I own an Altair™ 8080B system as follows:

- 8800B, 64K, 4SIO PORTS, 2PIO PORTS
- PROM BOOTSTRAP LOADER
- 2 ALTAIR™ FLOPPY DISC DRIVES
- 2 ADM3K's VIDEO TERMINALS
- 1 OKIDATA 110 LINE PRINTER
- 1 MPI LINE PRINTER
- RUNNING MITS BASIC VER. 4.0

PAYROLL

This is a package of seven programs which are fast and efficient. The package contains three additional utility programs which make file maintainance a breeze.

Refer to program PA1 for the hardware requirements for this package. I'm sure with some ingenuity, the whole package could be modified to work on almost any configuration with a mass storage device.

My payroll consists of approximately 22 employees. You don't have to produce a mound of paper work to run the programs. The only source documents are the employees' time cards and the payroll status sheet. It takes me a total of approximately 30 minutes to add the time cards, transfer the data to the status sheets, enter the data into the computer, compute the payroll and run the weekly payroll register. Super, Huh!

First of all let us look at the file structure. This is a floppy disc resident system. It is comprised of three file types:

- THE PAYROLL MASTER FILE 'PACURR' (PAYROLL CURRENT)
- THE PAYROLL MASTER FILE BACKUP 'PABKUP' (PAYROLL BACKUP)
- THE WEEKLY PAYROLL TRANSACTION FILES 'PAMO?YR' (PAYROLL MONTH, PERIOD, YEAR)

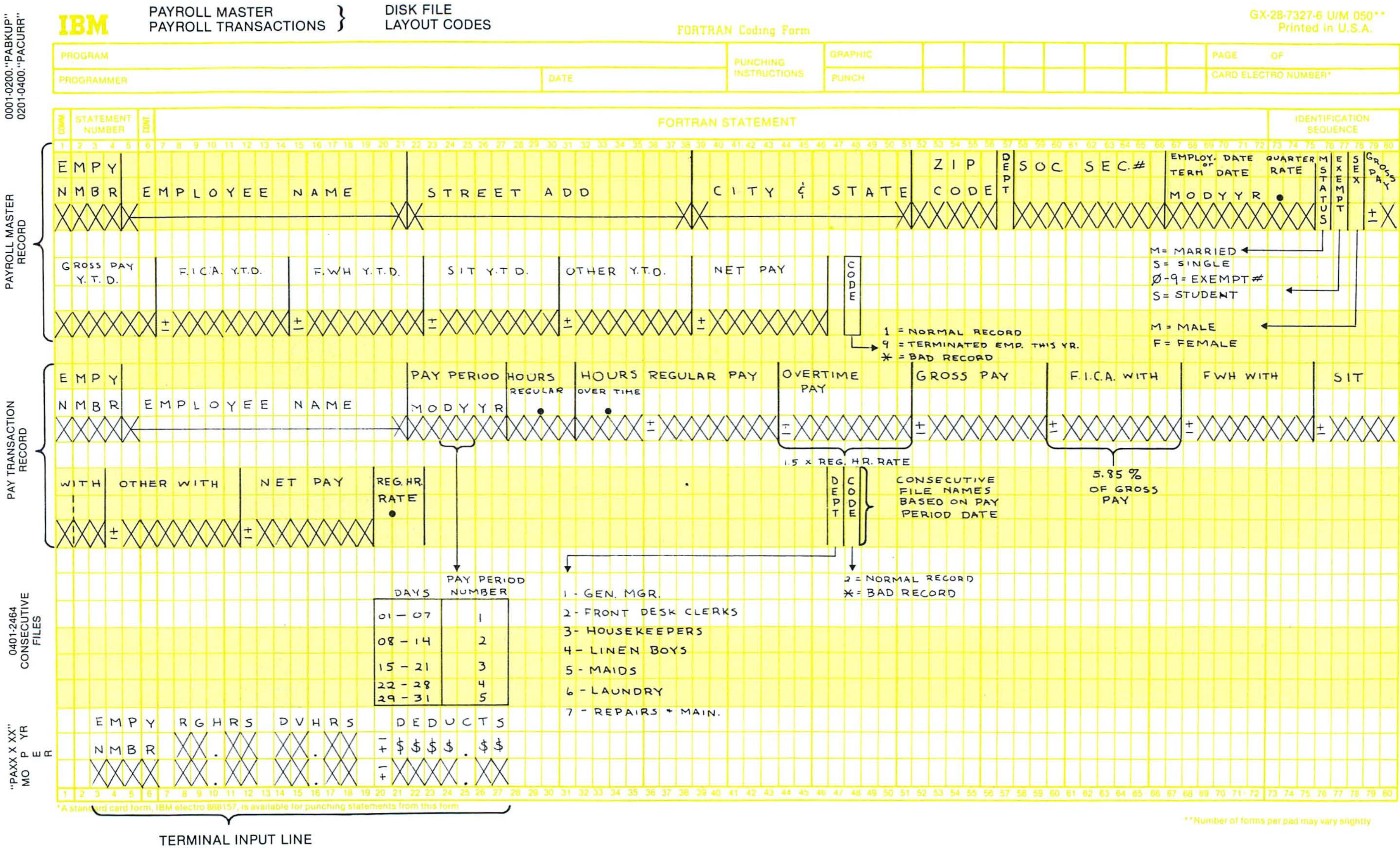
THE PAYROLL MASTER FILE—The payroll master file is a 'RANDOM' file residing on the disc in record blocks 201-400. Referring to the disc record layout, you will notice it contains all of the basic data needed to compute one's pay, except the actual hours worked and any miscellaneous deductions for a pay period. All of the money amounts represent the year to date totals applicable to this employee from January 1 to the current date. With each ensuing pay period, these totals are updated with the current pay period's totals.

You will notice this is a 'RAN-

PAYROLL STATUS SHEET

PERIOD ENDING

EMPLOYEE NUMBER	REGULAR HOURS	OVERTIME HOURS	DEDUCTIONS



DISC RECORDS — Payroll Master Record/Pay Transaction Record/Terminal Input Line (One time source documents)

DOM' file. However, it is not actually used as such. It is processed as though it were a consecutive file. There is a very good reason for this. Using MITS BASIC (all versions todate), as in most computer languages, you cannot up-date a consecutive file. That is, you cannot read it into memory, change its contents and write it back out to the same record location. You must write out an entirely new file, even those records you did not update. This is not so when using 'RANDOM' files. A random file may have a record read into memory, its contents changed and then the updated record written back out over the old record.

We would welcome any micro-fans traveling in this area to stop in, take a look at our system and see a first-hand demonstration of how your microcomputer can help you in running your business.

In a random file, you must specify the record number which you desire to access. This is simply done by using a consecutive counter starting at the desired location on the disc and incrementing each time by the size of the record blocks, in our case a one. Our consecutive counter starts at 201 and is checked each time for the file end record of 400.

PAYROLL MASTER BACKUP FILE — Any good systems design person worth his salt will tell you that it is extremely wise to have a backup file for the system. This gives you a starting point in the event of a major catastrophe, such as a power failure in the middle of updating a record and the file is scrambled, or let's say you made a mistake in computing the employees' time and didn't find the error until you were writing the payroll checks. With a backup file, you simply copy the 'PABKUP' to 'PACURR' and re-run your programs. It's important to copy the 'PACURR' to the 'PABKUP' just prior to running your payroll job. Since PABKUP is just a copy of 'PACURR' it is naturally a random file. It resides on the disc in record blocks 0001-0200. It is not referenced by any of the payroll programs but is just insurance against some unforeseen mishap. You will find it is a life saver.

THE WEEKLY PAYROLL TRANSACTION FILES—The weekly payroll transaction files 'PAMO?YR' are consecutive files. There is never a need to update their contents. They are the mirror image of the actual payroll period being processed. They are created when the payroll is computed and their file names are an extract of the payroll date. If for some reason, you have to re-run a payroll period do not panic. You can simply re-run the programs and the old file for that date will be gone. It will be replaced by the new file provided you use the same dates. The program which does the actual computations and creates these files (PA2) also contains provisions for by-passing the update of the payroll master. This proves handy sometimes for re-runs and trial runs.

The payroll files are recalled by the programs in producing the various payroll reports and making certain that they remain collectively in balance with the totals contained within the payroll master. Since this is a weekly payroll system, there will be 52 of these files on the disc at the end of a full calendar year's processing. The floppy disc will hold all three categories of files for a large number of employees.

The procedures presented with this discussion are more than adequate for running the programs. The programs are highly commented and practically self explanatory. Therefore, I will not go into detailed discussion of each program. However, you will notice program 'PA7' is not included in the package. This program is for the purpose of running employee W-2 forms at year's end. Since Uncle Sam is notorious for changing his forms, we have left the development of this rather simple program to the user.

UTILITY PROGRAMS

The utility programs included with the package deserve some explanation. The programs are:

- 'COPRAN'
- 'GETPUT'
- TVDUMPR'

'COPRAN' (Copy Random Data Files) — This is a utility program used for copying random data files. It allows the user to specify file names, file locations, and disc drive numbers. The files concerned may reside on the same or a different disc drive. It monitors the copying on the terminal. If you are using a teletype, you might want to delete the monitor provisions to speed up the copying.

'GETPUT' (Get and Put a Random Data File)—A utility program which allows the user to randomly update or change any position(s) within the 128-character record. The user specifies the file name, disc drive

number and record number. The program then gets the record and displays it on the terminal in a formatted form identifying each position by number. It requests the user to define the limits of the area he desires to change, then requests the user to enter his new data. It then writes out the new record over the old record and then re-reads the new record and dumps it out on the terminal for a visual inspection and comparison to the old record. I used this program to initially enter my employees Y.T.D. totals to the payroll master record, since I started my payroll system at a time other than January 1.

Don't try to use this program to locate records within a random file. It might alter the unwanted records you dump. Use the following program.

'TVDUMPR' (Dump a Random File on the Video Monitor and the Line Printer)—Allows the user to specify file name, record location, and disc drive number. This program dumps a random file on the video monitor and the OKIDATA 110 line printer. It does not identify the positions of the record, but is very useful for locating a record in a random file so 'GETPUT' can be run. Also very useful with a type-bar ruler and the line printer dump for checking the proper locations of data placed in a newly constructed file. MITS BASIC ignores the line printer instructions if the printer is not in a ready status, a nice feature if you don't want the hard copy print out.

MANUAL CHECK WRITING

You will notice there are no provisions in this system for printing the actual payroll checks. Since this is designed for a relatively small number of employees and the cost of form feed checks is rather expensive, we continue manually to write or type our same old inexpensive payroll checks.

OPEN INVENTION

I would welcome any micro-fans traveling to this area to stop in and take a look at our system and see a first hand demo of the payroll system, general ledger system, reservations and the other uses to which I have put my ALTAIR™.

Good luck and start enjoying your pay day!

PAYROLL PROCEDURES

STEP PROGRAM	ACTION
	WEEKLY
1. GETPUT	Tag all terminated employees
2. GETPUT	Make all pay increase, withholding etc., changes
3. PA1	Add new employees to -PACURR-
4. COPRAN	Copy payroll mstr -PACURR- to backup -PABKUP-
5. PA2	Enter weekly payroll info from status sheets (enter-L- to STOP input) & compute payroll
6. PA3	Run weekly payroll register
7.	Check run for errors
8.	Make journal voucher for ledger entries
9. COPRAN	After being certain that this payroll is O.K., Copy -PACURR- to PABKUP
	MONTHLY
1. PA3	Run monthly payroll register
2.	Balance weekly registers to monthly register
	QUARTERLY
1. PA3	Run quarterly payroll register
2.	Balance to monthly runs
	Y T D
1. PA3	Run YTD payroll register from transactions files
2. PA4	Run YTD payroll register from -PACURR-
3.	Balance the two runs for the year
4. PA7	Run W-2s on stock paper. Balance totals to YTD run
5. PA7	Run W-2s using -PACURR-
6. PA6	Run mailing labels for W-2s
7. PA5	Initialize new payroll master -PACURR-

AM-100

You have to SEE it to BELIEVE it!

The Alpha Microsystems AM-100 is LIGHT YEARS ahead of everything else you've seen so far in the low cost computing field.

For a FRACTION of what you'd normally pay for the SOFTWARE ALONE, you get a 16-bit processor with ALL of these BIG-SYSTEM capabilities:

MULTI-TASKING, MULTI-USER TIMESHARING

- ☆ DEVICE INDEPENDENT I/O
- ☆ ADVANCED FILE STRUCTURE
- ☆ POWERFUL SYSTEM COMMANDS
- ☆ SOPHISTICATED TEXT EDITOR
- ☆ FULL MACRO ASSEMBLER
- ☆ LINE PRINTER SPOOLER
- ☆ RE-ENTRANT, MULTI-USER BASIC *COMPILER*
- ☆ LARGE UTILITIES LIBRARY

Yet, with all this it's still compatible with the S-100 BUS!

If you like the Decsystem-10 operating system, if you like TECO . . . if you like the PDP-11 instruction set . . . you'll LOVE the AM-100!

ONLY
$1495
IN STOCK *NOW!*

NOW AT

BYTE SHOP
of Pasadena

496 S. LAKE AVE.
PASADENA, CA. 91101
PHONE: (213) 684-3311

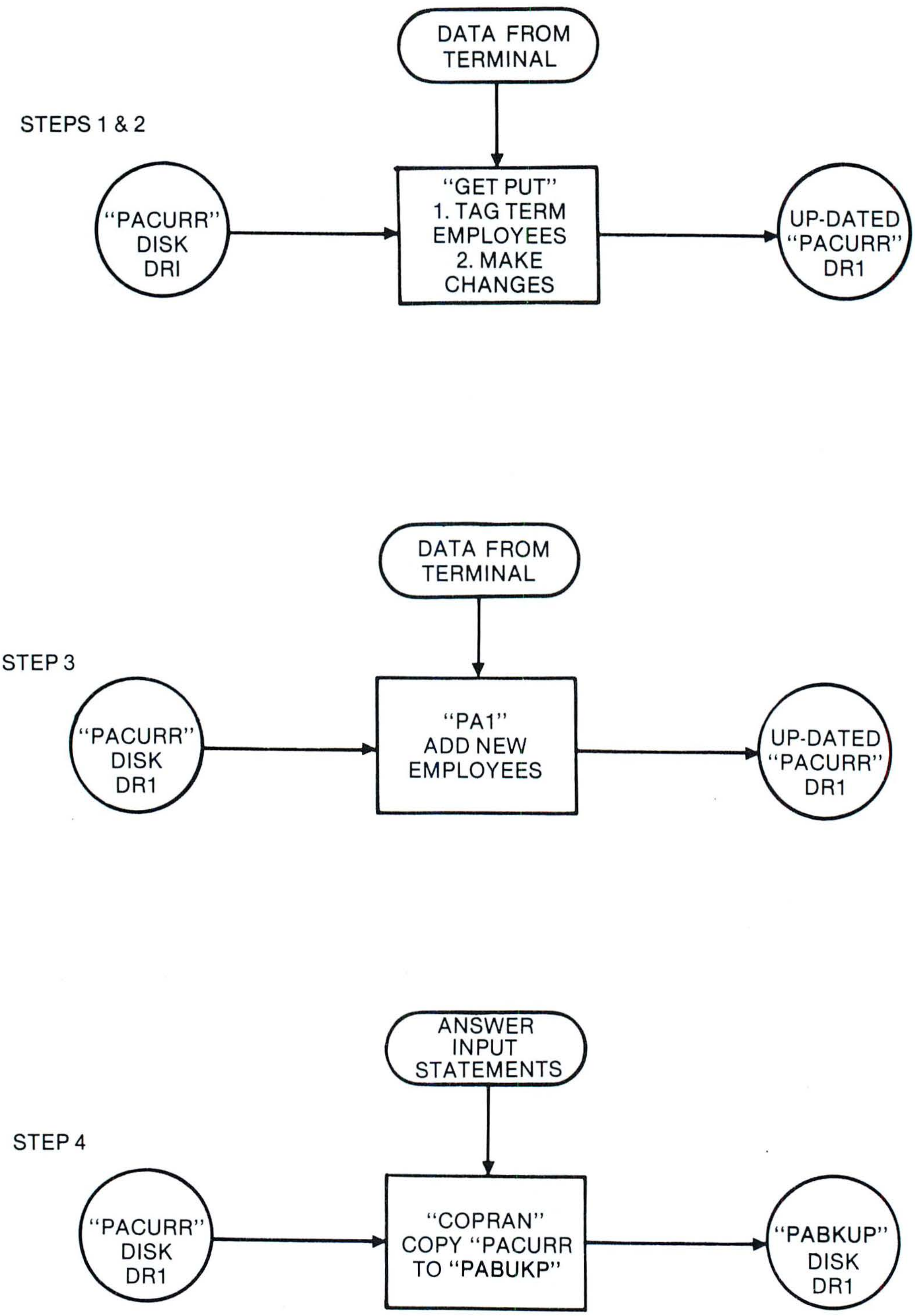
HOURS: Tuesday — Friday, 12:00 — 9:00;
Saturday & Sunday, 12:00 — 5:00;
Closed Mondays

master charge THE INTERBANK CARD

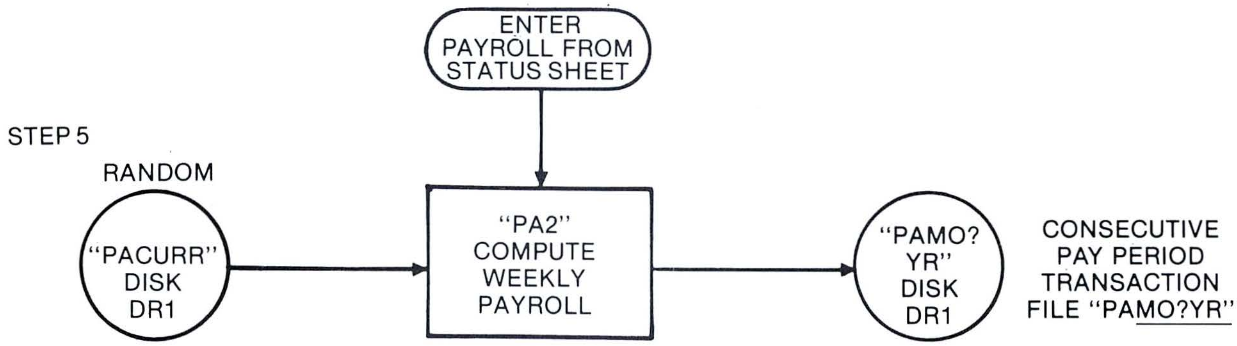
Your BANKAMERICARD welcome here

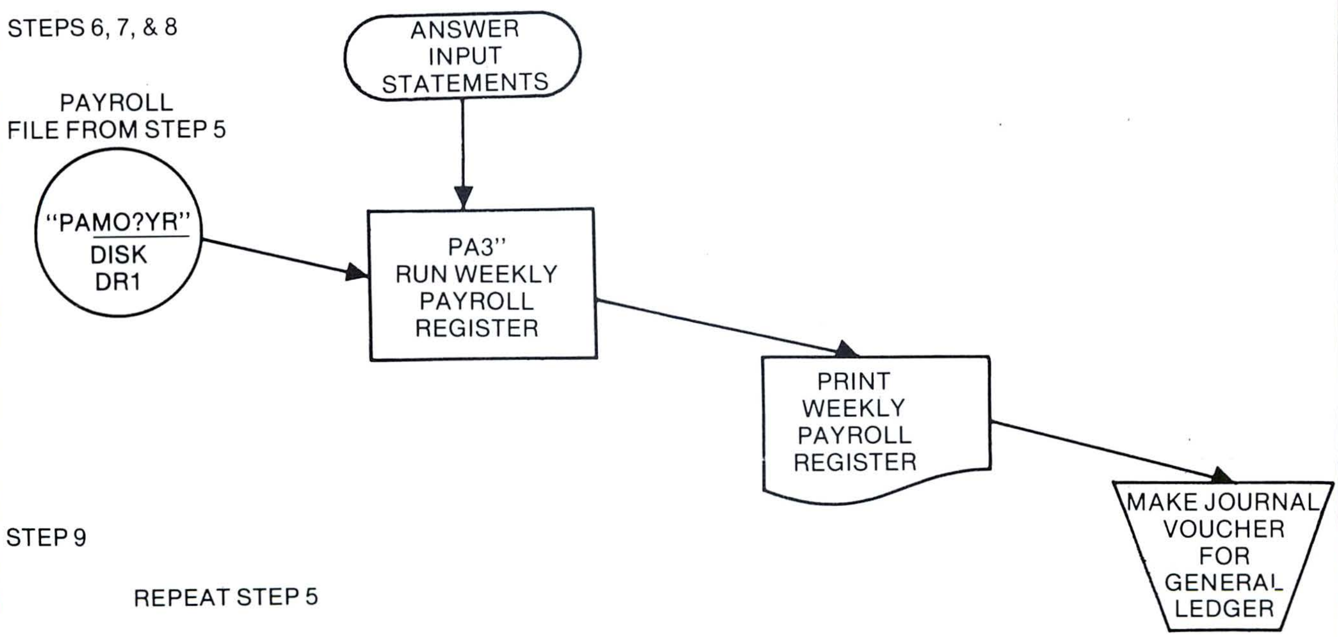
WEEKLY PAYROLL FLOW DIAGRAM

Weekly Payroll Procedure



WEEKLY P.P. CONT.





EXAMPLE OF WEEKLY PAYROLL REGISTER LISTING

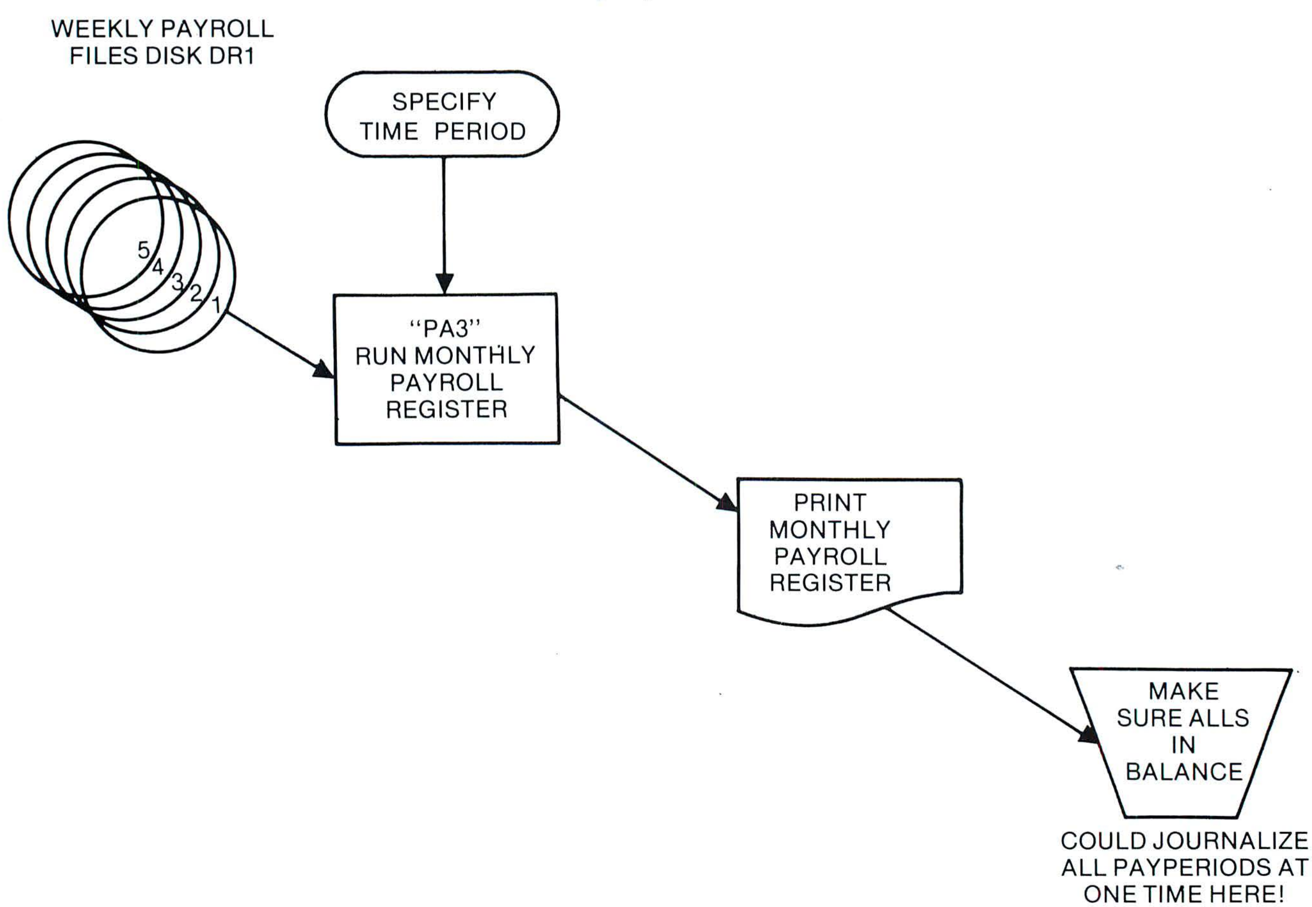
```
THIS IS A SAMPLE OF THE WEEKLY PAYROLL REGISTER

                         CONWAY RI INC

                       WEEKLY PAYROLL REGISTER
                       PERIOD ENDING 03-03-77              PAGE  1

-------------------------------------------------------------------------------
REGLR-PAY OV/TM-PAY GROSS-PAY  F I C A    F W H     S I T     DEDUCTS   NET-PAY
-------------------------------------------------------------------------------
   EMP.#         S.S.#        REG. HR. RATE  MARTIAL STATUS
                                             EXEMPTIONS
0001 GLENDA LOY BAKER  431257052 230 S1F5  DEPARTMENT
MODYYR RGHR OTHR RTE                       SEX
030377 2525 0000 230
    58.08      0.00     58.08      3.40      3.10      0.20      0.00     51.38
   PAY PERIOD DATE

0002 SANDY BLAXTON     430064734 230 SSF5
MODYYR RGHR OTHR RTE
030377 1025 0000 230
    23.58      0.00     23.58      1.38      0.00      0.00      0.00     22.20

0004 DAISY HART        432681062 230 M2F6
MODYYR RGHR OTHR RTE
030377 2600 0000 230
    59.80      0.00     59.80      3.50      0.00      0.10      0.00     56.20

0007 KATHY KELLEY      587922672 235 SSF2
MODYYR RGHR OTHR RTE
030377 4600 0000 235
   108.10      0.00    108.10      6.32      0.00      0.00      0.00    101.78

0008 LARRY E KELSO     429947718 250 M1M2
MODYYR RGHR OTHR RTE
030377 3450 0000 250
    86.25      0.00     86.25      5.05      4.20      0.80      0.00     76.20

0009 ANDREW F MCGEE    428988500 230 SSM2
MODYYR RGHR OTHR RTE
030377 3050 0000 230
    70.15      0.00     70.15      4.10      0.00      0.00      0.00     66.05

0010 CAROLYN PEACOCK   430020016 235 M2F5
MODYYR RGHR OTHR RTE
030377 3050 0000 235
    71.68      0.00     71.68      4.19      0.00      0.38      0.00     67.11

0011 JOSEPHINE POWELL  429625594 265 SSF3
MODYYR RGHR OTHR RTE
030377 2000 0000 265
    53.00      0.00     53.00      3.10      0.00      0.00      0.00     49.90
```

```
                         CONWAY RI INC

                       WEEKLY PAYROLL REGISTER
                       PERIOD ENDING 03-03-77              PAGE  2

-------------------------------------------------------------------------------
REGLR-PAY OV/TM-PAY GROSS-PAY  F I C A    F W H     S I T     DEDUCTS   NET-PAY
-------------------------------------------------------------------------------

0012 JANET PRIOR       360329027 255 M6F2
MODYYR RGHR OTHR RTE
030377 3300 0000 255
    84.15      0.00     84.15      4.92      0.00      0.23      0.00     79.00

0013 BETTY ROBERTSON   430310555 230 S2F5
MODYYR RGHR OTHR RTE
030377 1950 0000 230
    44.85      0.00     44.85      2.62      0.00      0.00      0.00     42.23

0014 GERALDINE REPINE  432721869 230 S1F5
MODYYR RGHR OTHR RTE
030377 3600 0000 230
    82.80      0.00     82.80      4.84      7.00      0.70      0.00     70.26

0015 JD SHAMBURGER JR  429312682 230 SSM7
MODYYR RGHR OTHR RTE
030377 1875 0000 200
    37.50      0.00     37.50      2.19      0.00      0.00      0.00     35.31

0016 TROY POWELL       429214259 230 SSM4
MODYYR RGHR OTHR RTE
030377 1750 0000 200
    35.00      0.00     35.00      2.05      0.00      0.00      0.00     32.95

0017 MARY V WEBB       431113499 235 SSF6
MODYYR RGHR OTHR RTE
030377 1750 0000 235
    41.13      0.00     41.13      2.41      0.00      0.00      0.00     38.72

0018 JULIE WIEDEMAN    386160929 250 S1F5
MODYYR RGHR OTHR RTE
030377 3700 0000 250
    92.50      0.00     92.50      5.41      9.00      0.91      0.00     77.18

0019 MARY YOWELL       429116992 240 SSF2
MODYYR RGHR OTHR RTE
030377 1875 0000 240
```

MONTHLY/QUARTERLY PAYROLL FLOW DIAGRAM

STEPS 1 & 2

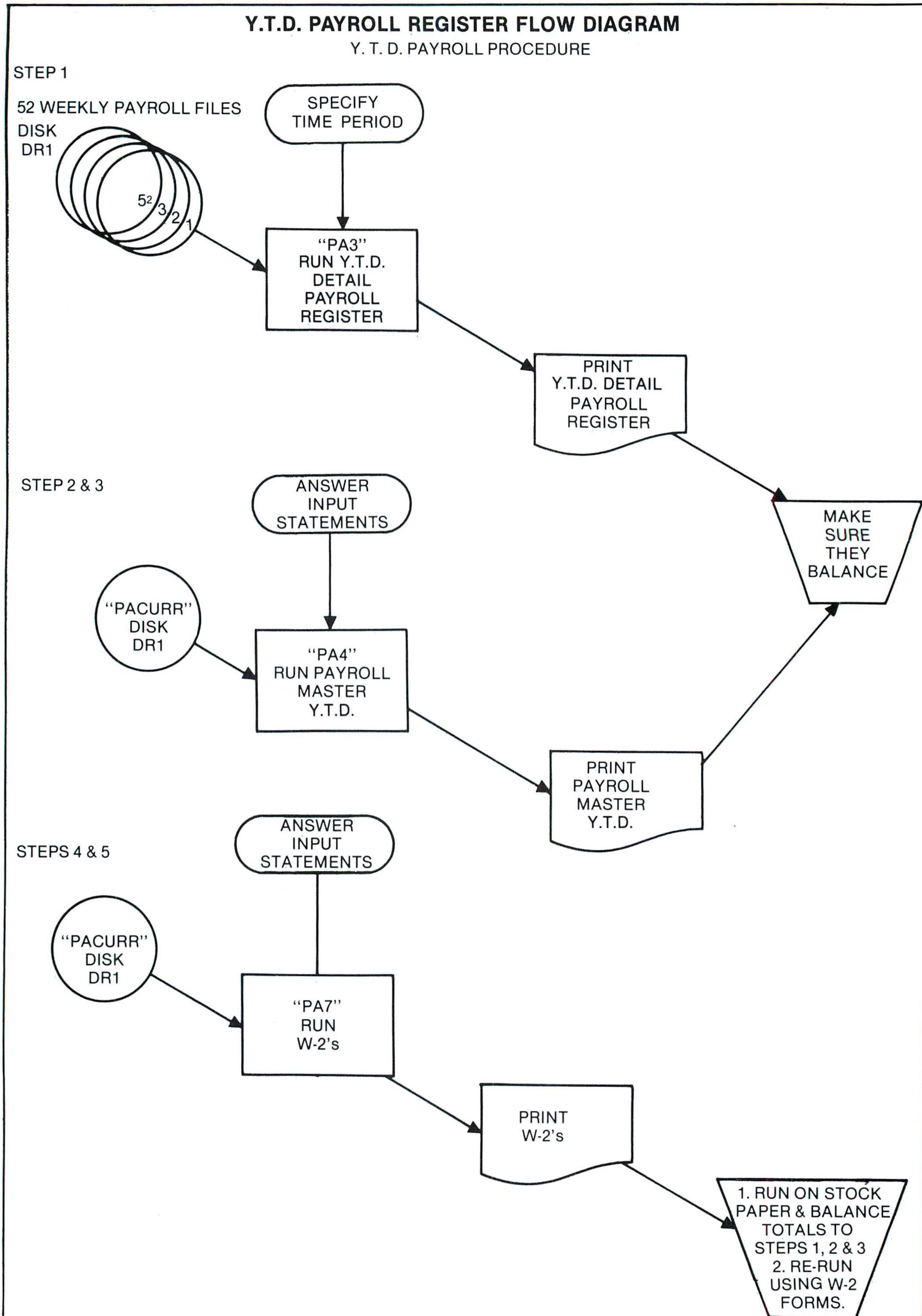
Monthly Payroll Procedure
Quarterly Payroll Procedure

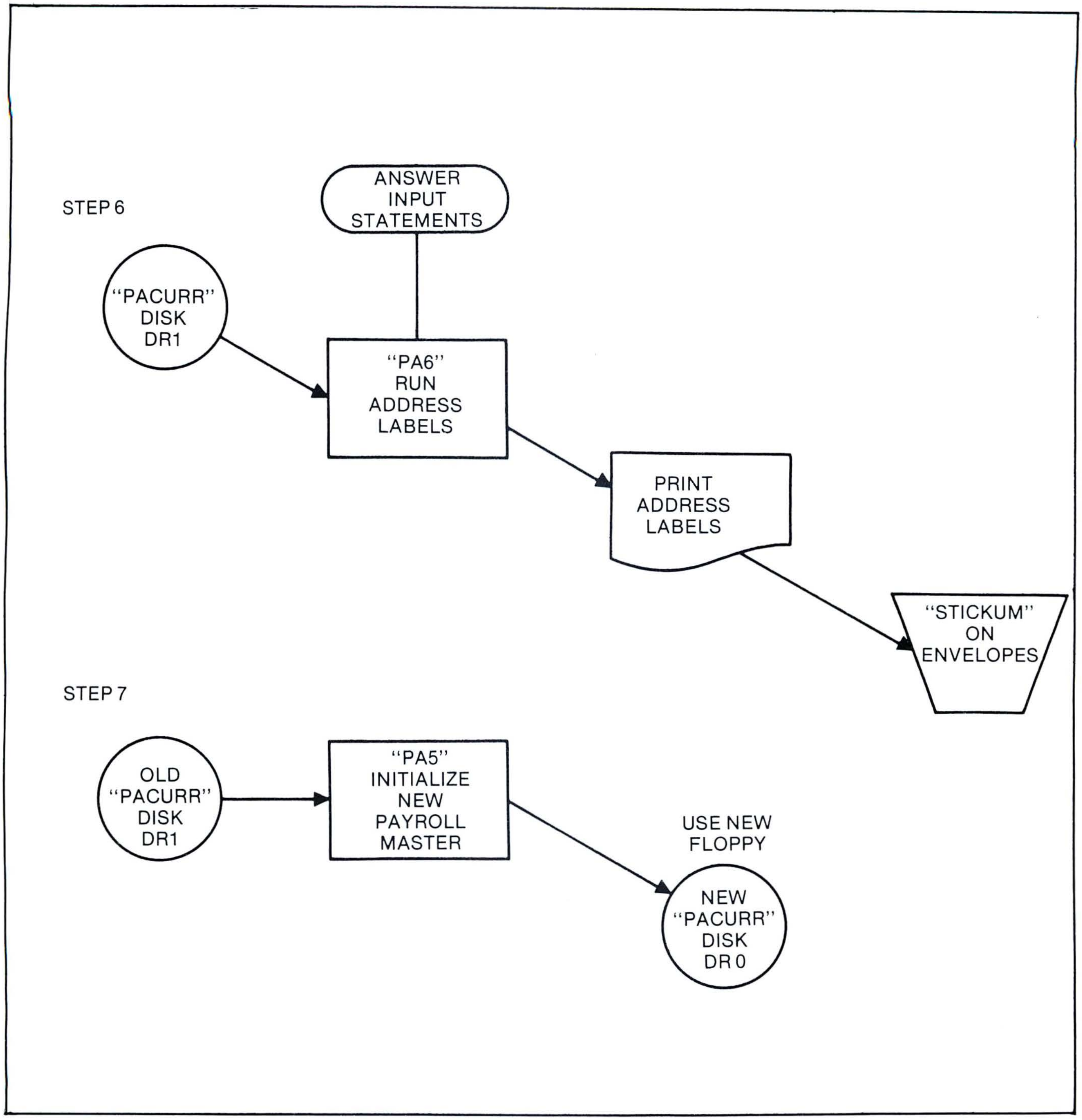


```
                    CONWAY RI INC

                    WEEKLY PAYROLL REGISTER
                    PERIOD ENDING 03-03-77              PAGE  3

-----------------------------------------------------------------------
REGLR-PAY OV/TM-PAY GROSS-PAY  F I C A    F W H    S I T    DEDUCTS   NET-PAY
-----------------------------------------------------------------------

   45.00      0.00     45.00      2.63     0.00     0.00      0.00     42.37

0020 JD SHAMBURGER     432660001 750 MSM1
MODYYR RGHR OTHR RTE
030377 5000 0000 750
  375.00      0.00    375.00     21.94     0.00     0.00      0.00    353.06

0021 MA SHAMBURGER     430668460 750 MSF1
MODYYR RGHR OTHR RTE
030377 5000 0000 750
  375.00      0.00    375.00     21.94     0.00     0.00      0.00    353.06

1,743.57      0.00  1,743.57    101.99    23.30     3.32      0.00  1,614.96
              JOURNAL  VOUCHER

        D E B I T S                 C R E D I T S

7100 GEN MANAGER     750.00    1110 BANK        1,614.96
7101 DESK CLERKS     393.65    2109 SIT             3.32
7102 HOUSEKEEPER      53.00    2110 FWH            23.30
7103 LINEN BOYS       35.00    2111 FICA          101.99
7104 MAIDS           373.49    ???? DEDUCTS         0.00
7105 LAUNDRY         100.93
7602 REPAIRS&MAIN     37.50
   TOTAL           1,743.57         TOTAL       1,743.57
```

EXAMPLE OF MONTHLY/QUARTERLY PAYROLL REGISTER LISTING

```
THIS IS A SAMPLE OF A MONTHLY, QUARTERLY OR YTD PAYROLL REGISTER
RUN FROM THE WEEKLY PAYROLL PERIOD TRANSACTION FILES
                    CONWAY RI INC

                    YTD PAYROLL REGISTER
                    PERIOD ENDING 03-14-77              PAGE  1

-----------------------------------------------------------------------
REGLR-PAY OV/TM-PAY GROSS-PAY  F I C A    F W H    S I T    DEDUCTS   NET-PAY
-----------------------------------------------------------------------

0001 GLENDA LOY BAKER  431257052 230 S1F5
MODYYR RGHR OTHR RTE
030377 2525 0000 230
   58.08      0.00     58.08      3.40     3.10     0.20      0.00     51.38
MODYYR RGHR OTHR RTE
031077 3750 0000 230
   86.25      0.00     86.25      5.05     7.80     0.80      0.00     72.60
  144.33      0.00    144.33      8.45    10.90     1.00      0.00    123.98

0002 SANDY BLAXTON     430064734 230 SSF5
MODYYR RGHR OTHR RTE
030377 1025 0000 230
   23.58      0.00     23.58      1.38     0.00     0.00      0.00     22.20
MODYYR RGHR OTHR RTE
031077 1400 0000 230
   32.20      0.00     32.20      1.88     0.00     0.00      0.00     30.32
   55.78      0.00     55.78      3.26     0.00     0.00      0.00     52.52

0004 DAISY HART        432681062 230 M2F6
MODYYR RGHR OTHR RTE
030377 2600 0000 230
   59.80      0.00     59.80      3.50     0.00     0.10      0.00     56.20
MODYYR RGHR OTHR RTE
031077 2450 0000 230
   56.35      0.00     56.35      3.30     0.00     0.08      4.75     48.22
  116.15      0.00    116.15      6.80     0.00     0.18      4.75    104.42

0007 KATHY KELLEY      587922672 235 SSF2
MODYYR RGHR OTHR RTE
030377 4600 0000 235
  108.10      0.00    108.10      6.32     0.00     0.00      0.00    101.78
MODYYR RGHR OTHR RTE
031077 4025 0000 235
   94.59      0.00     94.59      5.53     0.00     0.00      0.00     89.06
  202.69      0.00    202.69     11.85     0.00     0.00      0.00    190.84

0008 LARRY E KELSO     429947718 250 M1M2
MODYYR RGHR OTHR RTE
030377 3450 0000 250
   86.25      0.00     86.25      5.05     4.20     0.80      0.00     76.20
MODYYR RGHR OTHR RTE
031077 3475 0000 250


                    CONWAY RI INC

                    YTD PAYROLL REGISTER
                    PERIOD ENDING 03-14-77              PAGE  2

-----------------------------------------------------------------------
REGLR-PAY OV/TM-PAY GROSS-PAY  F I C A    F W H    S I T    DEDUCTS   NET-PAY
-----------------------------------------------------------------------

   86.88      0.00     86.88      5.08     4.20     0.80      0.00     76.80
  173.13      0.00    173.13     10.13     8.40     1.60      0.00    153.00

0009 ANDREW F MCGEE    428988500 230 SSM2
MODYYR RGHR OTHR RTE
030377 3050 0000 230
   70.15      0.00     70.15      4.10     0.00     0.00      0.00     66.05
MODYYR RGHR OTHR RTE
031077 4400 0275 230
  101.20      9.49    110.69      6.48     0.00     0.00      0.00    104.21
  171.35      9.49    180.84     10.58     0.00     0.00      0.00    170.26

0010 CAROLYN PEACOCK   430020016 235 M2F5
MODYYR RGHR OTHR RTE
030377 3050 0000 235
   71.68      0.00     71.68      4.19     0.00     0.38      0.00     67.11
MODYYR RGHR OTHR RTE
031077 1875 0000 235
   44.06      0.00     44.06      2.58     0.00     0.00      0.00     41.48
  115.74      0.00    115.74      6.77     0.00     0.38      0.00    108.59

0011 JOSEPHINE POWELL  429625594 265 SSF3
MODYYR RGHR OTHR RTE
030377 2000 0000 265
   53.00      0.00     53.00      3.10     0.00     0.00      0.00     49.90
MODYYR RGHR OTHR RTE
031077 2000 0000 265
   53.00      0.00     53.00      3.10     0.00     0.00      0.00     49.90
  106.00      0.00    106.00      6.20     0.00     0.00      0.00     99.80

0012 JANET PRIOR       360329027 255 M6F2
MODYYR RGHR OTHR RTE
030377 3300 0000 255
   84.15      0.00     84.15      4.92     0.00     0.23      0.00     79.00
MODYYR RGHR OTHR RTE
031077 4400 0375 255
  112.20     14.34    126.54      7.40     0.00     1.42      0.00    117.72
  196.35     14.34    210.69     12.32     0.00     1.65      0.00    196.72

0013 BETTY ROBERTSON   430310555 230 S2F5
MODYYR RGHR OTHR RTE
030377 1950 0000 230


                    CONWAY RI INC

                    YTD PAYROLL REGISTER
                    PERIOD ENDING 03-14-77              PAGE  3

-----------------------------------------------------------------------
REGLR-PAY OV/TM-PAY GROSS-PAY  F I C A    F W H    S I T    DEDUCTS   NET-PAY
-----------------------------------------------------------------------

   44.85      0.00     44.85      2.62     0.00     0.00      0.00     42.23
MODYYR RGHR OTHR RTE
031077 1075 0000 230
   24.73      0.00     24.73      1.45     0.00     0.00      0.00     23.28
   69.58      0.00     69.58      4.07     0.00     0.00      0.00     65.51

0014 GERALDINE REPINE  432721869 230 S1F5
MODYYR RGHR OTHR RTE
030377 3600 0000 230
   82.80      0.00     82.80      4.84     7.00     0.70      0.00     70.26
MODYYR RGHR OTHR RTE
031077 3175 0000 230
   73.03      0.00     73.03      4.27     5.40     0.49      0.00     62.87
  155.83      0.00    155.83      9.11    12.40     1.19      0.00    133.13

0015 JD SHAMBURGER JR  429312682 230 SSM7
MODYYR RGHR OTHR RTE
030377 1875 0000 200
   37.50      0.00     37.50      2.19     0.00     0.00      0.00     35.31
MODYYR RGHR OTHR RTE
031077 1775 0000 230
   40.83      0.00     40.83      2.39     0.00     0.00      0.00     38.44
   78.33      0.00     78.33      4.58     0.00     0.00      0.00     73.75

0016 TROY POWELL       429214259 230 SSM4
MODYYR RGHR OTHR RTE
030377 1750 0000 200
   35.00      0.00     35.00      2.05     0.00     0.00      0.00     32.95
MODYYR RGHR OTHR RTE
031077 1725 0000 230
   39.68      0.00     39.68      2.32     0.00     0.00      0.00     37.36
   74.68      0.00     74.68      4.37     0.00     0.00      0.00     70.31

0017 MARY V WEBB       431113499 235 SSF6
MODYYR RGHR OTHR RTE
030377 1750 0000 235
   41.13      0.00     41.13      2.41     0.00     0.00      0.00     38.72
MODYYR RGHR OTHR RTE
031077 1150 0000 235
   27.03      0.00     27.03      1.58     0.00     0.00      0.00     25.45
   68.16      0.00     68.16      3.99     0.00     0.00      0.00     64.17


                    CONWAY RI INC

                    YTD PAYROLL REGISTER
                    PERIOD ENDING 03-14-77              PAGE  4

-----------------------------------------------------------------------
REGLR-PAY OV/TM-PAY GROSS-PAY  F I C A    F W H    S I T    DEDUCTS   NET-PAY
-----------------------------------------------------------------------

0018 JULIE WIEDEMAN    386160929 250 S1F5
MODYYR RGHR OTHR RTE
030377 3700 0000 250
   92.50      0.00     92.50      5.41     9.00     0.91      0.00     77.18
MODYYR RGHR OTHR RTE
031077 2950 0000 250
   73.75      0.00     73.75      4.31     5.40     0.49      0.00     63.55
  166.25      0.00    166.25      9.72    14.40     1.40      0.00    140.73

0019 MARY YOWELL       429116992 240 SSF2
MODYYR RGHR OTHR RTE
030377 1875 0000 240
   45.00      0.00     45.00      2.63     0.00     0.00      0.00     42.37
MODYYR RGHR OTHR RTE
031077 1200 0000 240
   28.80      0.00     28.80      1.68     0.00     0.00      0.00     27.12
   73.80      0.00     73.80      4.31     0.00     0.00      0.00     69.49

0020 JD SHAMBURGER     432660001 750 MSM1
MODYYR RGHR OTHR RTE
030377 5000 0000 750
  375.00      0.00    375.00     21.94     0.00     0.00      0.00    353.06
  375.00      0.00    375.00     21.94     0.00     0.00      0.00    353.06

0021 MA SHAMBURGER     430668460 750 MSF1
MODYYR RGHR OTHR RTE
030377 5000 0000 750
  375.00      0.00    375.00     21.94     0.00     0.00      0.00    353.06
  375.00      0.00    375.00     21.94     0.00     0.00      0.00    353.06

0023 MARGARET S BRYANT 429042119 230 S2F5
MODYYR RGHR OTHR RTE
031077 0700 0000 230
   16.10      0.00     16.10      0.94     0.00     0.00      0.00     15.16
   16.10      0.00     16.10      0.94     0.00     0.00      0.00     15.16

2,734.25     23.83  2,758.08    161.33    46.10     7.40      4.75  2,538.50
              JOURNAL  VOUCHER

        D E B I T S                 C R E D I T S

7100 GEN MANAGER     750.00    1110 BANK        2,538.50
7101 DESK CLERKS     841.15    2109 SIT             7.40
7102 HOUSEKEEPER     106.00    2110 FWH            46.10
7103 LINEN BOYS       74.68    2111 FICA          161.33
7104 MAIDS           723.61    ???? DEDUCTS         4.75
7105 LAUNDRY         184.31
7602 REPAIRS&MAIN     78.33
   TOTAL           2,758.08         TOTAL       2,758.08
```


Y.T.D. PAYROLL REGISTER FLOW DIAGRAM
Y. T. D. PAYROLL PROCEDURE
STEP 1
52 WEEKLY PAYROLL FILES
DISK
DR1
52
3
2
1
SPECIFY TIME PERIOD
"PA3" RUN Y.T.D. DETAIL PAYROLL REGISTER
PRINT Y.T.D. DETAIL PAYROLL REGISTER
STEP 2 & 3
ANSWER INPUT STATEMENTS
"PACURR" DISK DR1
"PA4" RUN PAYROLL MASTER Y.T.D.
PRINT PAYROLL MASTER Y.T.D.
MAKE SURE THEY BALANCE
STEPS 4 & 5
ANSWER INPUT STATEMENTS
"PACURR" DISK DR1
"PA7" RUN W-2's
PRINT W-2's
1. RUN ON STOCK PAPER & BALANCE TOTALS TO STEPS 1, 2 & 3
2. RE-RUN USING W-2 FORMS.



EXAMPLE OF Y.T.D. PAYROLL REGISTER LISTING

THIS IS A SAMPLE OF THE YTD PAYROLL REGISTER RUN FROM THE PAYROLL MASTER FILE - PACURR

CONWAY RI INC

PAYROLL MASTER YTD
PERIOD ENDING 03-14-77 PAGE 1

SOC-SEC CRT MEX D	GROSS-PAY	F I C A	F W H	S I T	DEDUCTS	NET-PAY
0001 GLENDA LOY BAKER 431257052 230 S1F5	634.23	37.10	38.60	3.25	0.00	555.28
0002 SANDY BLAXTON 430064734 230 SSF5	241.52	14.13	0.00	0.00	0.00	227.39
0003 REX GERMANY 409067833 235 S0M2	542.85	30.77	59.40	7.21	10.50	434.97
0004 DAISY HART 432681062 230 M2F6	757.29	44.30	8.60	3.28	4.75	696.36
0005 TERRY HOLT 432154550 235 SSM2	133.36	7.80	0.00	0.00	0.00	125.56
0006 MELBA J HOOKS 431764364 245 M0F5	77.18	4.51	0.00	0.39	0.00	72.28
0007 KATHY KELLEY 587922672 235 SSF2	793.12	46.38	0.00	0.00	0.00	746.74
0008 LARRY E KELSO 429947718 250 M1M2	759.36	44.43	26.30	5.87	0.00	682.76
0009 ANDREW F MCGEE 428988500 230 SSM2	385.54	22.55	0.00	0.00	0.00	362.99
0010 CAROLYN PEACOCK 430020016 235 M2F5	509.36	29.97	0.00	0.72	0.00	478.67
0011 JOSEPHINE POWELL 429625594 265 SSF3	530.00	31.00	0.00	0.00	0.00	499.00
0012 JANET PRIOR 360329027 255 M6F2	1,096.30	64.11	21.80	8.48	0.00	1,001.91
0013 BETTY ROBERTSON 430310555 230 S2F5	433.56	25.38	0.90	0.10	0.00	407.18
0014 GERALDINE REPINE 432721869 230 S1F5	676.78	39.58	48.30	4.11	0.00	584.79
0015 JD SHAMBURGER JR 429312682 230 SSM7	256.33	14.98	0.00	0.00	0.00	241.35
0016 TROY POWELL 429214259 230 SSM4	389.68	22.79	0.00	0.00	0.00	366.89

```
          CONWAY RI INC      PAYROLL MASTER YTD
                           PERIOD ENDING 03-14-77         PAGE  2

--------------------------------------------------------------------------------
  SOC-SEC CRT MEX D GROSS-PAY  F I C A    F W H     S I T     DEDUCTS   NET-PAY
--------------------------------------------------------------------------------

0017 MARY V WEBB
431113499 235 SSF6    381.32     22.31      0.00      0.00      0.00    359.01

0018 JULIE WIEDEMAN
386160929 250 S1F5    745.65     44.13     55.40      5.43      0.00    640.69

0019 MARY YOWELL
429116992 240 SSF2    355.68     20.79      0.00      0.00      0.00    334.89

0020 JD SHAMBURGER
432660001 750 MSM1  1,875.00    109.70      0.00      0.00      0.00  1,765.30

0021 MA SHAMBURGER
430668460 750 MSF1  1,875.00    109.70      0.00      0.00      0.00  1,765.30

0022 GREG PRIOR
432136295 220 SSM6     26.40      1.54      0.00      0.00      0.00     24.86

0023 MARGARET S BRYANT
429042119 230 S2F5     16.10      0.94      0.00      0.00      0.00     15.16

         TOTAL     13,491.61    788.89    259.30     38.84     15.25 12,389.33
```

PA1 PROGRAM

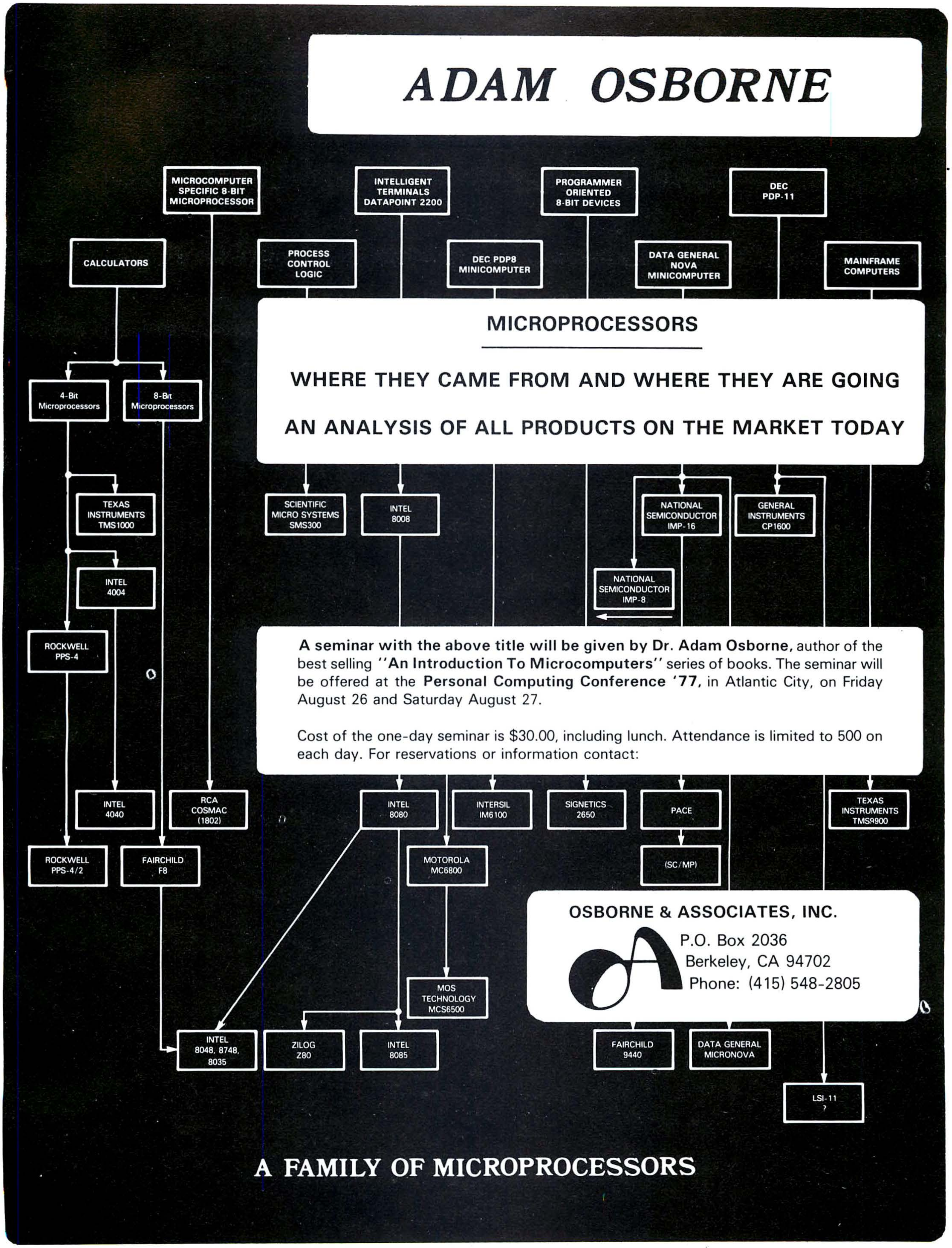
```
10 ' PROGRAM NAME "PA1"
20 ' MITS BASIC VERSION 4.0
30 ' PROGRAMMED BY:  BUD SHAMBURGER,   FEB 1977
                     #27 RED OAK DR
                     CONWAY, ARK  72032   501-327-3641
40 '
50 ' THIS PROGRAM IS CURRENTLY BEING RUN ON THE FOLLOWING SYSTEM:
        A.  ALTAIR 8800 B,64K,SIO,PIO,PROM BOOTSTRAP LOADER
        B.  2 ALTAIR DISK DRIVES
        C.  1 ADM3K
        D.  1 OKIDATA 110 LINE PRINTER
60 '
70 ' THIS IS THE INITIAL PROGRAM OF A 7 SERIES PAYROLL PACKAGE WHICH
80 ' MAINTAINS A COMPLETE ACCOUNTING SYSTEM FOR A WEEKLY-HOURLY PAYROLL
90 ' THIS PROGRAM ADDS EMPLOYEES TO THE PAYROLL MASTER RECORD FILE
100 ' ENTITLED "PACURR".  IT CAN ALSO BE USED TO CONSTRUCT THE INITIAL
110 ' FILE(WITH THE EXCEPTION OF THE Y.T.D.PAYROLL DATA).  INCLUDED
120 ' WITH THIS PACKAGE ARE THREE UTILITY PROGRAMS WHICH ONE WILL FIND
130 ' VERY USEFUL IN FILE MAINTANENCE.  THEY ARE "TVDUMPR", "GETPUT" AND
140 ' "COPRAN".  "GETPUT" CAN BE USED IN ENTERING THE INITIAL EMPLOYEE
150 ' Y.T.D.  DATA AFTER THE BASIC INFORMATIONS HAS BEEN CREATED USING
160 ' THIS PROGRAM.  "COPRAN" IS USED IN COPYING "PACURR" TO "PABKUP"
170 ' AT CERTAIN TIMES DURING ACTUAL JOB RUNS.  THEY ARE
180 ' ALSO VERY USEFUL IN MAKING VARIOUS CHANGES TO THE MASTER RECORD
190 ' IE; WAGE INCREASES, ADDRESS CHANGES ETC.
200 ' "PACURR" IS A RANDOM FILE RESIDING ON DISK DRIVE 1 IN RECORD BLOCKS
210 ' 201-400.  IT HAS A BACKUP FILE ENTITLED "PABKUP" RESIDING ON THE
220 ' SAME DISK IN RECORD BLOCKS 1-200.  "PACURR" IS ALWAYS COPIED TO
230 ' "PABKUP" PRIOR TO RUNNING ANY PROGRAM WHICH UPDATES OR ALTERS THE
240 ' MASTER RECORD.  ENTER -EOF- TO TERMINATE INPUT DATA
250 '
260 ' MINIMUM HARDWARE REQUIREMENTS FOR THE PAYROLL PACKAGE USING
270 ' MITS BASIC VER 3.4 OR VER 4.0 = 28K, HARDCOPY PRINTER(TERMINAL)
                                      1 DISK DRIVE AND REMOVAL
                                      OF ALL REMARKS AND SPACES
                                      FROM PROGRAM.  3.4 USERS
280 '                                 SHOULD BE AWARE OF 4.0
                                      CHANGES,IE; NEW INSTRUCTIONS.
290 '
300 '*****************************************************************
310 ' CLEAR 1000
320 ' PRINT "ADD NEW EMPLOYEES TO -PACURR-"
330 ' PRINT "ENTER -Y- TO MOUNT THE FILE";WY$
340 IF WY$<>"Y" THEN 360
350 UNLOAD 1:MOUNT 1
360 OPEN "R",1,"PACURR",1
370 B1$="
380 REC=200
390 '****************************************************************
400 '******* GET THE PAYROLL MASTER RECORD AND FIND THE FIRST AVAILABLE
410 '******* BLANK RECORD OR THE END OF FILE.
420 '*************************************************************
430 REC=REC+1
440 GET #1,REC
450 FIELD #1,78 AS D$,50 AS DC$
460 IF MID$(D$,1,4)<"0001" THEN 520
470 IF MID$(D$,1,3)="EOF" THEN 520
480 GOTO 430
490 '***********************************************************
500 '********** SET UP THE TERMINAL INPUT HEADINGS
510 '***********************************************************
520 H1$="EMPY"
530 H2$="ZIP   D"
540 HA$="SOCIAL    EMPMNT HRS SEM"
550 H3$=" CODE.  E"
560 HB$="SECURITY# MODYYR RTE MXF"
570 H4$="NMBR EMPLOYEE NAME....  STREET ADDRESS...  CITY & STATE."
580 PRINT SPC(2);H1$;SPC(51);H2$
590 PRINT SPC(2);H4$;H3$
600 '***********************************************************
610 ' ********* INPUT THE EMPLOYEE DATA AND EDIT FOR ERRORS
620 '***********************************************************
630 INPUT LN$
640 IF MID$(LN$,1,3)="EOF" THEN 920
650 L=LEN(LN$)
660 IF MID$(LN$,L,1)="/" THEN 580
670 IF L<>62 THEN PRINT CHR$(7);CHR$(7);CHR$(7);CHR$(7):GOTO 580
680 PRINT SPC(2);HA$
690 PRINT SPC(2);HB$
700 INPUT LIN$
710 LH=LEN(LIN$)
720 IF LH<>24 THEN 680
730 IF MID$(LIN$,22,1)="M" THEN 750
740 IF MID$(LIN$,22,1)<>"S" THEN PRINT CHR$(7);CHR$(7):GOTO 680
750 IF MID$(LIN$,23,1)="S" THEN 770
760 IF MID$(LIN$,23,1)>"9" THEN PRINT CHR$(7);CHR$(7):GOTO 680
770 IF MID$(LIN$,24,1)="M" THEN 790
780 IF MID$(LIN$,24,1)<>"F" THEN PRINT CHR$(7);CHR$(7):GOTO 680
790 DLN$=MID$(LN$,1,4)+MID$(LN$,6,17)+MID$(LN$,24,17)+MID$(LN$,42,13)
800 DLN$=DLN$+MID$(LN$,56,5)+MID$(LN$,62,1)
810 DLN$=DLN$+MID$(LIN$,1,9)+MID$(LIN$,11,6)+MID$(LIN$,18,3)
820 DLN$=DLN$+MID$(LIN$,22,3)
830 LSET D$=DLN$
840 IF MID$(LN$,1,3)="EOF" THEN RSET DC$=B1$+"           ":GOTO890
850 RSET DC$="1"
860 '***********************************************************
870 '********** WRITE THE NEW EMPLOYEE DATA TO THE MASTER FILE
880 '***********************************************************
890 PUT #1,REC
900 IF MID$(LN$,1,3)="EOF" THEN 940
910 GOTO 430
920 DLN$="EOF"+B1$+B1$
930 GOTO 830
940 PRINT "EOJ"
950 END
```

PA2 PROGRAM

```
10 ' PROGRAM NAME "PA2"
20 ' MITS BASIC VERSION 4.0
30 ' PROGRAMMED BY:  BUD SHAMBURGER,   FEB 1977 .
                     #27 RED OAK DR.
                     CONWAY ARK  72032   501-327-3641
40 '
50 ' A PROGRAM TO COMPUTE THE WEEKLY PAYROLL FOR HOURLY EMPLOYEES.
60 ' OVERTIME IS COMPUTED AT 1.5 X THE REGULAR HOURLY RATE, FICA AT
70 ' 5.85% OF GROSS PAY.  FEDERAL WITHHOLDING(FWH) AND STATE WITHHOLDING
80 ' (ARKANSAS SIT) ARE LOOKED UP IN DATA TABLES CONTAINED WITHIN THE
90 ' PROGRAM.  MISC DEDUCTIONS ARE ENTERED FOR THE PAYROLL PERIOD AT
100 ' RUN TIME ALONG WITH THE CURRENT REGULAR HOURS WORKED AND OVERTIME
110 ' HOURS WORKED(IF ANY).  THE DATA ENTERED DOES NOT HAVE TO BE IN
120 ' EMPLOYEE NUMBER ORDER SINCE THIS PROGRAM CONTAINS ITS OWN SORT
130 ' ROUTINE TO ARRANGE THE DATA IN EMPLOYEE NUMBER ORDER FOR PROCESS-
140 ' ING.
150 '
160 ' THE DATA FOR THE PAYROLL PERIOD IS ENTERED FROM THE TERMINAL
170 ' FROM A -PAYROLL STATUS SHEET- WHICH CONTAINS THE EMP#, REG HRS.
180 ' OVERTIME HRS. AND DEDUCTIONS.  IT IS EDITED, SORTED.AND
190 ' MATCHED AGAINST THE PAYROLL MASTER RECORD IN "PACURR".  THE EMPLOYEE
200 ' NAME, REGULAR HOURLY PAY RATE ETC. . AND OTHER INFORMATION NEEDED TO
210 ' TO COMPUTE THE PAYROLL IS EXTRACTED FROM THE PAYROLL MASTER RECORD.
220 ' THE PAY PERIOD IS COMPUTED AND A CONSECTIVE OUTPUT FILE IS CREATED
230 ' FOR THIS WEEKS PAY BASED ON THE DATE ENTERED FROM THE TERMINAL AT
240 ' RUN TIME.  THIS FILE NAME WILL BE CONSTRUCTED AS FOLLOWS:
          "PAMO?YR" - PA WILL PREFIX ALL FILE NAMES
                    - MO WILL EQUAL THE CURRENT MONTH ENTERED
                    - ?  WILL EQUAL THE PAYPERIOD FROM 1 - 5
250 '               - YR WILL EQUAL THE CURRENT YEAR ENTERED
260 '             *** EACH PAYPERIOD WILL HAVE A SEPARATE FILE NAME ***
270 '             *** WHICH CAN BE RECONSTRUCTED BY ADDITION ***
280 '
290 ' THE YEAR TO DATE (Y.T.D.) INFORMATION ON THE PAYROLL MASTER "PACURR"
300 ' IS UPDATED AND WRITTEN BACK TO THE MASTER RECORD.
310 '
320 ' ALL FILES ARE ON DISK DRIVE 1
330 '
340 ' PROVISIONS HAVE BEEN MADE IN THE PROGRAM TO BYPASS UPDATING
350 ' THE MASTER RECORD WHEN COMPUTING THE PAYROLL PERIOD.  THIS IS
360 ' USEFUL SOMETIMES WHEN TESTING OR MAKING TRIAL RUNS FOR ACCOUNTING
370 ' PURPOSES.  TO DO SO, ANSWER -NO- TO THE PROPER INPUT STATEMENT.
380 '
390 ' ***** ENTER -L- TO THE REQUEST FOR ADDITIONAL EMPLOYEE INFORMATION
400 ' ***** TO TERMINATE THE INPUT OF DATA.
410 '
420 '*******************************************************************
430 '*******************************************************************
440 '
450 CLEAR 1500
460 DIM B(100),CB$(100)  'MATRIX FOR DATA ENTERED FROM TERMINAL
470 ZER$="00000000"
480 PRINT "COMPUTE PAYROLL PERIOD":PRINT "ENTER -L- TO STOP INPUT":
490 PRINT "PREFIX HOURS WITH HIGH ORDER ZERO'S (0)":PRINT
500 REC=200  'FILE START-PAYROLL MASTER=200+1
510 INPUT "ENTER PAY PERIOD DATE AS MODYYR";DT$
520 INPUT "ENTER -Y- TO MOUNT FILE";WY$
530 INPUT"ENTER -NO- TO BYPASS MASTER UPDATE";YN$
540  IF WY$<>"Y" THEN  560
550 UNLOAD 1:MOUNT1
560 OPEN "R",1,"PACURR",1
570 '
580 '*******************************************************************
590 '********** COMPUTE OUTPUT FILE NAME BASED ON DATE ENTERED
600 '*******************************************************************
610 '
620 IF MID$(DT$,3,2)=>"01" AND MID$(DT$,3,2)<="07" THEN P$="1":GOTO670
630 IF MID$(DT$,3,2)=>"08" AND MID$(DT$,3,2)<="14" THEN P$="2":GOTO670
640 IF MID$(DT$,3,2)=>"15" AND MID$(DT$,3,2)<="21" THEN P$="3":GOTO670
650 IF MID$(DT$,3,2)=>"22" AND MID$(DT$,3,2)<="28" THEN P$="4":GOTO 670
660 P$="5"
670 NA$="PA"+MID$(DT$,1,2)+P$+MID$(DT$,5,2)'  OUTPUT FILE NAME
680 OPEN "O",2,NA$,1
690 FOR J=1 TO 99
700 '
710 '*******************************************************************
720 ' ********* SET UP FOR TERMINAL INPUT OF PAYROLL DATA
730 '*******************************************************************
740 '
750 PRINT "  EMPY RGHRS OVHRS  DEDUCTS"
760 PRINT "  NMBR --.-- --.-- -$$$$.$$"
770 '
780 '*******************************************************************
790 '********** INPUT PAYROLL DATA AND EDIT FOR ERRORS
800 '*******************************************************************
810 '
820 INPUT LN$
830 IF MID$(LN$,1,1)="L" THEN 1000 ' ENTER -L- TO STOP INPUT OF DATA
840 L=LEN(LN$)
850 IF L<10 THEN 2930
860 IF L>10 AND L<16 THEN 2930
870 IF L>16 AND L<25 THEN 2930
880 IF L>25 THEN 2930
890 IF MID$(LN$,12,5)="     "THENMID$(LN$,12,5)="00.00"
900 IF MID$(LN$,12,1)=" " THEN 2930
910 FOR I=1 TO L
920 IF MID$(LN$,1,1)>"9" AND MID$(LN$,1,I)<>"."THEN 2930
930 NEXT I
940 B(J)=VAL(MID$(LN$,1,4))
950 BB$=MID$(LN$,6,2)+MID$(LN$,9,2)
960 IF L>10 THEN BB$=BB$+MID$(LN$,12,2)+MID$(LN$,15,2)
970 IF L>16 THEN BB$=BB$+MID$(LN$,18,5)+MID$(LN$,24,2)
980 CB$(J)=BB$
990 NEXT J
1000 N=J-1
1010 '
1020 '*******************************************************************
1030 '********** GO SORT DATA ENTERED ON EMPLOYEE NUMBER
1040 '*******************************************************************
1050 '
1060 GOSUB 2720          'GO SORT ON EMPLOYEE #
1070 PRINT "WORKING"
1080 FOR J=1 TO N
1090 '
1100 '*******************************************************************
1110 '********** GET THE PAYROLL MASTER - "PACURR" FOR THIS EMPLOYEE
1120 '*******************************************************************
1130 '
1140 REC=REC+1
1150 GET #1,REC
1160 FIELD #1,4 AS EMPD$,68 AS B1$,3 AS RRD$,1 AS MSD$,1 AS EXD$,
         1 AS SXD$,8 AS GPD$,8 AS FID$,8 AS FWD$,8AS SID$,8 AS OTD$,
         8 AS NTD$,1 AS B2$,1 AS COD$
1170 IF COD$="9" OR COD$="*" THEN 1140   'BY PASS
1180 IF MID$(EMPD$,1,3)="EOF" THEN 2660' END OF PAYROLL MSTR
1190 DED$=MID$(B1$,53,1)
1200 EMPD=VAL(EMPD$)
1210 IF B(J)>EMPD THEN 1140' GET NEXT MSTR RECORD
1220 IF B(J)<EMPD THEN PRINT "NO MSTR RECORD  FOR ";B(J):J=J+1:GOTO1210
1230 '           EQUAL
1240 ' *** COMPUTE GROSS REG PAY ***  -RP-
1250 '
1260 XRP$=" "
1270 PRR$=RRD$:PRR$=MID$(PRR$,1,1)+"."+MID$(PRR$,2,2):RR=VAL(PRR$)
1280 BB$=CB$(J)
1290 CC$=MID$(BB$,1,2)+"."+MID$(BB$,3,2)
1300 RH$=MID$(BB$,1,4)
1310 RH=VAL(CC$)     'REG HOURS
1320 RP=RR*RH:RP=RP+5E-03' REG RATE X REG HOURS
1330 RP$=STR$(RP)
1340 L=LEN(RP$)
1350 FOR I=1 TO L
1360 IF MID$(RP$,I,1)="."THEN XRP$=XRP$+MID$(RP$,I+1,2):GOTO 1390
1370 XRP$=XRP$+MID$(RP$,I,1)
1380 NEXT I
1390 RP=VAL(XRP$)          'GROSS REG PAY IN -RP-
1400 L=LEN(BB$):IF L<5 THEN OHR$="0000":GOTO 1580
1410 IF MID$(BB$,5,4)="0000" THEN OHR$="0000":GOTO 1580
1420 OHR$=MID$(BB$,5,4)
1430 '
1440 '  *** COMPUTE OVERTIME PAY ***
1450 '
```

```
1460 XOP$=" "
1470 DD$=MID$(BB$,5,2)+"."+MID$(BB$,7,2)
1480 OTR=RR*1.5                'COMPUTE OVERTIME RATE
1490 OH=VAL(DD$)               'OVERTIME HOURS
1500 OP=OTR*OH:OP=OP+5E-03  'OVERTIME PAY=OVERTIME RATE X OVERTIME HRS
1510 OP$=STR$(OP)
1520 L=LEN(OP$)
1530 FOR I=1 TO L
1540 IF MID$(OP$,I,1)="."THENXOP$=XOP$+MID$(OP$,I+1,2):GOTO 1570
1550 XOP$=XOP$+MID$(OP$,I,1)
1560 NEXT I
1570 OP=VAL(XOP$)            'GROSS OVERTIME PAY IN -OP-
1580 GP=VAL(GPD$)
1590 GP=GP+RP+OP
1600 A1$=STR$(GP)
1610 RSET GPD$=A1$          'GROSS PAY YTD IN -GPD$-
1620 PGP=RP+OP                 'GROSS PAY THIS PAY PERIOD IN -PGP-
1630 '
1640 '  *** COMPUTE FICA ***
1650 '
1660 ZFI$=STR$(PGP)
1670 L=LEN(ZFI$)
1680 XFI$=MID$(ZFI$,1,L-2)+"."+MID$(ZFI$,L-1,2)
1690 FI=VAL(XFI$)
1700 FI=FI*.0585
1710 FI=FI+5E-03
1720 ZFI$=STR$(FI)
1730 XFI$=" "
1740 L=LEN(ZFI$)
1750 FOR I=1 TO L
1760 IF MID$(ZFI$,I,1)="."THEN XFI$=XFI$+MID$(ZFI$,I+1,2):GOTO 1790
1770 XFI$=XFI$+MID$(ZFI$,I,1)
1780  NEXT I
1790 FI=VAL(XFI$)            'FICA THIS PAY PERIOD IN -FI-
1800 DFI=VAL(FID$)
1810 DFI=DFI+FI
1820 A2$=STR$(DFI)
1830 RSET FID$=A2$          'FICA  YTD IN -FID$-
1840 IF EXD$="S" THEN 2030  'STUDENT -  NO WITHHOLDING
1850 '
1860 ' *** GO FIND FWH ***
1870 GOSUB 2970                'GO FIND FWH IN TABLE = TO -FW-
1880 DFW=VAL(FWD$)
1890 DFW=DFW+FW'   FWH THIS PAY PERIOD IN -FW-
1900 A3$=STR$(DFW)
1910 L=LEN(A3$):A3$=MID$(A3$,1,1)+MID$(ZER$,1,8-L)+MID$(A3$,2,L-1)
1920 RSET FWD$=A3$          'FED WITH TAX YTD IN -FWD$-
1930 '
1940 ' *** GO FIND SIT IN TABLE ***
1950 '
1960 GOSUB 3470
1970 DSI=VAL(SID$)
1980 DSI=DSI+SI                'SIT THIS PAY PERIOD IN -SI-
1990 A4$=STR$(DSI)
2000 L=LEN(A4$):A4$=MID$(A4$,1,1)+MID$(ZER$,1,8-L)+MID$(A4$,2,L-1)
2010 RSET SID$=A4$          'STATE INC TAX YTD IN -SID$-
2020 '
2030 ' *** COMPUTE OTHER DEDUCTIONS ***
2040 '
2050 L=LEN(BB$)
2060 IF L<13 THEN 2150
2070 EE$=MID$(BB$,9,7)
2080 OD=VAL(EE$)               'OTHER DEDUCTS THIS PAY PERIOD IN -OD-
2090 DOT=VAL(OTD$)
2100 DOT=DOT+OD
2110 A5$=STR$(DOT)
2120 L=LEN(A5$):A5$=MID$(A5$,1,1)+MID$(ZER$,1,8-L)+MID$(A5$,2,L-1)
2130 RSET OTD$=A5$          'OTHER DEDUCTS YTD IN -OTD$-
2140 '
2150 ' *** COMPUTE NET PAY ***
2160 '
2170 DNT=VAL(NTD$)
2180 NT=PGP-FI-FW-SI-OD
2190 DNT=DNT+NT
2200 A6$=STR$(DNT)
2210 L=LEN(A6$):A6$=MID$(A6$,1,1)+MID$(ZER$,1,8-L)+MID$(A6$,2,L-1)
2220 RSET NTD$=A6$         'NET PAY YTD IN -NTD$-
2230 PRP$=STR$(RP)           'REG PAY THIS PAY PERIOD
2240 OOP$=STR$(OP)           'OVERTIME PAY THIS PAY PERIOD
2250 OGP$=STR$(PGP)          'GROSS PAY THIS PAY PERIOD
2260 OFI$=STR$(FI)           'FICA THIS PAY PERIOD
2270 OWF$=STR$(FW)           'FWH THIS PAY PERIOD
2280 OSI$=STR$(SI)           'SIT THIS PAY PERIOD
2290 ODE$=STR$(OD)           'OTHER DEDUCTS THIS PAYPERIOD
2300 PNT$=STR$(NT)           'NET PAY THIS PAY PERIOD
2310 '
2320 '***************************************************************
2330 '********** CONSTRUCT OUTPUT FILE IN PROPER FORMAT
2340 '********** NO DECIMAL POINTS IN DISK RECORD AND RIGHT JUSTIFY
2350 '***************************************************************
2360 '
2370 L=LEN(PRP$):PRP$=MID$(PRP$,1,1)+MID$(ZER$,1,8-L)+MID$(PRP$,2,L-1)
2380 L=LEN(OOP$):OOP$=MID$(OOP$,1,1)+MID$(ZER$,1,8-L)+MID$(OOP$,2,L-1)
2390 L=LEN(OGP$):OGP$=MID$(OGP$,1,1)+MID$(ZER$,1,8-L)+MID$(OGP$,2,L-1)
2400 L=LEN(OFI$):OFI$=MID$(OFI$,1,1)+MID$(ZER$,1,8-L)+MID$(OFI$,2,L-1)
2410 L=LEN(OWF$):OWF$=MID$(OWF$,1,1)+MID$(ZER$,1,8-L)+MID$(OWF$,2,L-1)
2420 L=LEN(OSI$):OSI$=MID$(OSI$,1,1)+MID$(ZER$,1,8-L)+MID$(OSI$,2,L-1)
2430 L=LEN(ODE$):ODE$=MID$(ODE$,1,1)+MID$(ZER$,1,8-L)+MID$(ODE$,2,L-1)
2440 L=LEN(PNT$):PNT$=MID$(PNT$,1,1)+MID$(ZER$,1,8-L)+MID$(PNT$,2,L-1)
2450 O$=EMPD$+MID$(B1$,1,17)+DT$
2460 O$=O$+RH$+OHR$
2470 O$=O$+PRP$+OOP$+OGP$+OFI$+OWF$+OSI$+ODE$+PNT$+RRD$+SPACE$(24)+DED$+"2"
2480 '
2490 '***************************************************************

2500 '********** WRITE OUTPUT FILE FOR THIS PAYPERIOD
2510 '***************************************************************
2520 '
2530 PRINT #2,O$
2540 IF YN$="NO" THEN 2600  ' DO NOT UPDATE MASTER - THIS TIME - TESTING
2550 '
2560 '********** WRITE UPDATED PAYROLL MASTER RECORD - "PACURR"
2570 '***************************************************************
2580 '
2590 PUT #1,REC              'WRITE UPDATED MSTR RECORD
2600 RP=0:OP=0:PGP=0:FI=0:FW=0:SI=0:OD=0:NT=0    'CLEAR COUNTERS
2610 RESTORE       ' RESET THE DATA TABLE POINTER
2620 NEXT J      'GO GET NEXT EMPLOYEE FROM SORTED LIST IN MATRIX
2630 CLOSE       'ALL EMPLOYESS PROCESSED - CLOSE ALL FILES
2640 PRINT "EOJ"  ' ALL DATA PROCESSED END OF JOB
2650 STOP
2660 IF J=N THEN 2630
2670 FOR I=J TO N
2680 PRINT "NO MSTR RECORD FOR ";B(I)
2690 NEXT I
2700 GOTO 2630
2710 '
2720 ' *** SORT ROUTINE *** SORT ON EMPLOYEE # ***
2730 '
2740 M=N
2750 M=INT(M/2)
2760 XEXH=0
2770 IF M=0 THEN 2910
2780 K=N-M
2790 JZ=1
2800 IZ=JZ
2810 L=IZ+M
2820 IF B(IZ)<=B(L) THEN 2880
2830 SWAP B(IZ),B(L)
2840 SWAP CB$(IZ),CB$(L)
2850 XEXH=XEXH+1
2860 IZ=IZ-M
2870 IF IZ>=1 THEN 2810
2880 JZ=JZ+1
2890 IF JZ>K THEN PRINT "M = "M" SWAPS MADE ="XEXH:GOTO 2750
2900 GOTO 2800
2910 RETURN
```

```
2920 '
2930 ' *** LINE ERROR ROUTINE ***
2940 '
2950 PRINT CHR$(7);CHR$(7);CHR$(7);CHR$(7):GOTO 750
2960 '
2970 ' *** TABLE SEARCH FOR FWH ***
2980 YY=0
2990 PGP$=STR$(PGP)
3000 CK$=MSD$+EXD$
3010 '
3020 '*****************************************************************
3030 '********** NO FWH TAX ON THESE EMPLOYEE EARNING
3040 '*****************************************************************
3050 '
3060 IF CK$="S1" AND PGP<4000 THEN FW=0:GOTO 3430
3070 IF CK$="S2" AND PGP<5400 THEN FW=0:GOTO 3430
3080 IF CK$="S3" AND PGP<6800 THEN FW=0:GOTO 3430
3090 IF CK$="S4" AND PGP<8400 THEN FW=0:GOTO 3430
3100 IF CK$="S5" AND PGP<9800 THEN FW=0:GOTO 3430
3110 IF CK$="S6" AND PGP<11000 THEN FW=0:GOTO 3430
3120 IF CK$="S7" AND PGP<12500 THEN FW=0:GOTO 3430
3130 IF CK$="S8" AND PGP<14000 THEN FW=0:GOTO 3430
3140 IF CK$="S9" AND PGP<16000 THEN FW=0:GOTO 3430
3150 IF CK$="M1" AND PGP<6200 THEN FW=0:GOTO 3430
3160 IF CK$="M2" AND PGP<7800 THEN FW=0:GOTO 3430
3170 IF CK$="M3" AND PGP<9200 THEN FW=0:GOTO 3430
3180 IF CK$="M4" AND PGP<10500 THEN FW=0:GOTO 3430
3190 IF CK$="M5" AND PGP<12000 THEN FW=0:GOTO 3430
3200 IF CK$="M6" AND PGP<13500 THEN FW=0:GOTO 3430
3210 IF CK$="M7" AND PGP<15000 THEN FW=0:GOTO 3430
3220 IF CK$="M9" AND PGP<18000 THEN FW=0:GOTO 3430
3230 '
3240 '*****************************************************************
3250 '********** FWH TAX ON THESE EMPLOYEE EARNINGS
3260 '*****************************************************************
3270 '
3280 L=LEN(PGP$)
3290 PGP$=MID$(PGP$,2,L-3)
3300 IF PGP>13000 THEN 3440
3310 PGP$=PGP$+"F"+MSD$+EXD$
3320 READ X$,Y
3330 L=LEN(X$)
3340 M=LEN(PGP$)
3350 VP=VAL(MID$(PGP$,1,M-3)):VX=VAL(MID$(X$,1,L-3))
3360 IF VP<25 AND MID$(PGP$,M-1,1)="S"THEN FW=0:GOTO 3430' THEN NO FWH
3370 IF VP<48 AND MID$(PGP$,M-1,1)="M" THEN FW=0:GOTO 3430 ' THEN NO FWH
3380 IF MID$(X$,L-2,1)<>"F" AND VP<131 THEN FW=0:GOTO 3430 ' THEN NO FWH
3390 IF MID$(X$,L-2,3)<>MID$(PGP$,M-2,3) THEN 3320
3400 IF VX<VP THEN YY=Y:GOTO 3320
3410 IF VX=VPANDMID$(PGP$,M-2,3)=MID$(X$,L-2,3)THENFW=Y:GOTO3430
3420 IF VX>VPANDMID$(PGP$,M-2,3)=MID$(X$,L-2,3)THENFW=YY
3430 RETURN
3440 PRINT EMPD$;" ";PGP$;" NOT IN FWH TABLE/USING -0-"
3450 GOTO 3430
3460 '
3470 ' *** TABLE SEARCH FOR SIT ***
3480 '
3490 YY=0
3500 PGP$=STR$(PGP)
3510 '
3520 '*****************************************************************
3530 '********** NO SIT ON THESE EMPLOYEE EARNINGS
3540 '*****************************************************************
3550 IF EXD$="2" AND PGP<4901 THEN SI=0:GOTO 3790
3560 IF EXD$="3" AND PGP<6101 THEN SI=0:GOTO 3790
3570 IF EXD$="4" AND PGP<6601 THEN SI=0:GOTO 3790
3580 IF EXD$="5" AND PGP<7001 THEN SI=0:GOTO 3790
3590 IF EXD$="6" AND PGP<7501 THEN SI=0:GOTO 3790
3600 IF EXD$="7" AND PGP<7901 THEN SI=0:GOTO 3790
3610 '
3620 '*****************************************************************
3630 '********** SIT ON THESE EMPLOYEE EARNINGS
3640 '*****************************************************************
3650 L=LEN(PGP$)
3660 PGP$=MID$(PGP$,2,L-3)
3670 IF PGP>13300 THEN 3800
3680 PGP$=PGP$+"S"+MSD$+EXD$
3690 READ X$,Y
3700 IF MID$(X$,1,3)="EOD" AND VP<134 THEN SI=0:GOTO 3790
3710 L=LEN(X$):M=LEN(PGP$)
3720 IF EXD$="0" THEN X$=MID$(X$,1,L-1)+MSD$+MID$(X$,L,1)
3730 IF EXD$="0"  THEN L=L+1
3745 IF MID$(X$,L-3,1)>''9'' THEN 3690
3740 IF MID$(X$,L-2,1)<>"S" THEN 3690
3750 VX=VAL(MID$(X$,1,L-3)):VP=VAL(MID$(PGP$,1,M-3))
3760 IF VP<35 THEN SI=0:GOTO 3790 ' THEN NO SIT
3770 IF MID$(X$,L-2,3)<>MID$(PGP$,M-2,3) THEN 3690
3780 IF VX>VPANDMID$(PGP$,M-2,3)=MID$(X$,L-2,3)THENSI=YELSE3690
3790 RETURN
3800 PRINT EMPD$;" ";PGP$;" NOT IN SIT TABLE/USING -0-"
3810 GOTO 3790
3820 '
3830 '       ******   DATA TABLES FOR FWH AND SIT   ******
3840 '
3850 '
3860 '*****************************************************************
3870 '********** DATA TABLES CONSTRUCTED AS FOLLOWS:
3880 '**** (DOLLAR AMOUNT OF GROSS PAY),(F=FEDERAL TABLE S=STATE TABLE)
3890 '**** (M=MARRIED S=SINGLE), (# OF EXEMPTION = 0 - 9 OR S=STUDENT)
3900 '**** (,XXXX = AMOUNT OF DEDUCTION IN DOLLARS AND CENTS)
3910 '*****************************************************************
3920 '
3930 '              **** TABLE FOR FWH  -  SINGLE ****
3940 '                  $00.00 - $130.00 OF GROSS PAY
3950 '
3960 DATA 25FS0,10,26FS0,20,27FS0,40,28FS0,60,29FS0,70,30FS0,90
3970 DATA 31FS0,100,32FS0,120,33FS0,140,34FS0,150,35FS0,170,36FS0,180
3980 DATA 37FS0,200,38FS0,220,39FS0,230,40FS0,250,40FS1,20,41FS0,260
3990 DATA 41FS1,30,42FS0,280,42FS1,50,43FS0,300,43FS1,70,44FS0,310
4000 DATA 44FS1,80,45FS0,330,45FS1,100,46FS0,340,46FS1,110,47FS0,360
4010 DATA 47FS1,130,48FS0,380,48FS1,150,49FS0,390,49FS1,160,50FS0,410
4020 DATA 50FS1,180,51FS0,420,51FS1,190,52FS0,440,52FS1,210,53FS0,460
4030 DATA 53FS1,230,54FS0,460,54FS1,230,54FS2,10,55FS0,490,55FS1,240
4040 DATA 55FS2,30,56FS0,500,56FS1,270,56FS2,40,57FS0,520,57FS1,290
4050 DATA 58FS0,540,58FS1,310,58FS2,70,59FS0,550,59FS1,320,59FS2,90
4060 DATA 60FS0,580,60FS1,350,60FS2,110
4070 DATA 62FS0,610,62FS1,380,62FS2,150
4080 DATA 64FS0,640,64FS1,410,64FS2,180
4090 DATA 66FS0,670,66FS1,440,66FS2,210
4100 DATA 68FS0,710,68FS1,470,68FS2,240,68FS3,10
4110 DATA 70FS0,750,70FS1,510,70FS2,270,70FS3,40
4120 DATA 72FS0,790,72FS1,540,72FS2,310,72FS3,80
4130 DATA 74FS0,830,74FS1,570,74FS2,340,74FS3,110
4140 DATA 76FS0,870,76FS1,600,76FS2,370,76FS3,140
4150 DATA 78FS0,910,78FS1,630,78FS2,400,78FS3,170
4160 DATA 80FS0,950,80FS1,670,80FS2,430,80FS3,200
4170 DATA 82FS0,990,82FS1,700,82FS2,470,82FS3,240
4180 DATA 84FS0,1030,84FS1,740,84FS2,500,84FS3,270,84FS4,40
4190 DATA 86FS0,1070,86FS1,780,86FS2,530,86FS3,300,86FS4,70
4200 DATA 88FS0,1110,88FS1,820,88FS2,560,88FS3,330,88FS4,100
4210 DATA 90FS0,1150,90FS1,860,90FS2,590,90FS3,360,90FS4,130
4220 DATA 92FS0,1190,92FS1,900,92FS2,630,92FS3,400,92FS4,160
4230 DATA 94FS0,1230,94FS1,940,94FS2,660,94FS3,430,94FS4,200
4240 DATA 96FS0,1270,96FS1,980,96FS2,690,96FS3,460,96FS4,230
4250 DATA 98FS0,1310,98FS1,1020,98FS2,730,98FS3,490,98FS4,260,98FS5,30
4260 DATA 100FS0,1380,100FS1,1090,100FS2,800,100FS3,550,100FS4,320
4270 DATA 100FS5,90
4280 DATA 105FS0,1480,105FS1,1190,105FS2,900,105FS3,630,105FS4,400
4290 DATA 105FS5,170
4300 DATA 110FS0,1580,110FS1,1290,110FS2,1000,110FS3,720,110FS4,720
4310 DATA 110FS5,250,110FS6,20
4320 DATA 115FS0,1690,115FS1,1390,115FS2,1100,115FS3,820,115FS4,560
4330 DATA 115FS5,330,115FS6,100,120FS0,1800,120FS1,1490,120FS2,1200
4340 DATA 120FS3,920,120FS4,640,120FS5,410,120FS6,180,125FS0,1920
4350 DATA 125FS1,1590,125FS2,1300,125FS3,1020,125FS4,730,125FS5,490
4360 DATA 125FS6,260,125FS7,201,130FS0,2030,130FS1,1700,130FS2,1400
4370 DATA 130FS3,1120,130FS4,830,130FS5,570,130FS6,340,130FS7,100
4380 '
4390 '       **** TABLE FOR FWH  -  MARRIED ****
```



CIRCLE INQUIRY NO. 99

```
4400 '               $00.00 - $130.00
4410 '
4420 DATA 48FM0,10,49FM0,20,50FM0,40,51FM0,60,52FM0,80,53FM0,90
4430 DATA 54FM0,110,55FM0,130,56FM0,140,57FM0,160,58FM0,180,59FM0,190
4440 DATA 60FM0,220,62FM0,250,62FM1,10,64FM0,290,66FM1,40,66FM0,320
4450 DATA 66FM1,80,68FM0,360,68FM1,110,70FM0,390,70FM1,140,72FM0,420
4460 DATA 72FM1,180,74FM0,460,74FM1,210,76FM0,490,76FM1,250,78FM0,530
4470 DATA 80FM0,560,80FM1,310,80FM2,70,82FM0,590,82FM1,350,82FM2,100
4480 DATA 84FM0,630,84FM1,380,84FM2,140,86FM0,660,86FM1,420,86FM2,170
4490 DATA 88FM0,700,88FM1,450,88FM2,210,90FM0,730,90FM1,480,90FM2,240
4500 DATA 92FM0,760,92FM1,520,92FM2,270,92FM3,30,94FM0,800,94FM1,550
4510 DATA 94FM2,310,94FM3,60,96FM0,830,96FM1,590,96FM2,340,96FM3,100
4520 DATA 98FM0,870,98FM1,620,98FM2,380,98FM3,130,100FM0,940
4530 DATA 100FM1,680,100FM2,430,100FM3,190,105FM0,1040,105FM1,770
4540 DATA 105FM2,520,105FM3,270,105FM4,30,110FM0,1140,110FM1,860
4550 DATA 110FM2,600,110FM3,360,110FM4,110,115FM0,1240,115FM1,960
4560 DATA 115FM2,690,115FM3,440,115FM4,200,120FM0,1340,120FM1,1060
4570 DATA 120FM2,770,120FM3,530,120FM4,280,120FM5,40,125FM0,1440
4580 DATA 125FM1,1160,125FM2,870,125FM3,610,125FM4,370,125FM5,120
4590 DATA 130FM0,1540,130FM1,1260,130FM2,970,130FM3,700,130FM4,450
4600 DATA 130FM5,210
4610 '
4620 ' *** TABLE FOR SIT - 0 EXEMPTIONS -SINGLE & MARRIED ***
4630 '                  $00.00 - $115.00
4640 '
4650 '*****************************************************************
4660 '********** THIS TABLE DOESNOT CONTAIN A MARITAL CODE\
4670 '*****************************************************************
4680 '
4690 '
4700 DATA 250,02,550,05,750,07,950,09,1250,12,1450,14
4710 DATA 1650,16,1850,18,2150,21,2350,23,2550,25,2850,28
4720 DATA 3050,30,3250,32,3550,35,3750,37,3950,39,4250,42
4730 DATA 4450,44,4650,46,5150,51,5550,55,6050,63,6550,75
4740 DATA  6950,87,7450,98,7850,110,8350,121,8850,133
4750 DATA 9250,144,9750,156,10250,167,10650,179,11150,190
4760 DATA 11550,202
4770 '
4780 '              **** TABLE FOR SIT  -  SINGLE ****
4790 '                  $00.00  -  133.00 OF GROSS PAY
4800 '
4810 DATA 34SS1,00,40SS1,03,42SS1,05,44SS1,06,46SS1,08
4820 DATA 48SS1,10,49SS1,11,52SS1,13,52SS2,02,54SS1,15
4830 DATA 54SS2,04,56SS1,17,56SS2,06,59SS1,20,59SS2,08
4840 DATA 61SS1,22,61SS2,10,66SS1,28,66SS2,17,66SS3,05
4850 DATA 70SS1,39,70SS2,27,70SS3,16,70SS4,04,75SS1,49
4860 DATA 75SS2,38,75SS3,26,75SS4,14,79SS1,59,79SS2,48
4870 DATA 79SS3,36,79SS4,25,79SS5,13,79SS6,02,84SS1,70
4880 DATA 84SS2,58,84SS3,47,84SS4,35,84SS5,24,84SS6,12
4890 DATA 84SS7,01,89SS1,80,89SS2,69,89SS3,57,89SS4,46,89SS5,34
4900 DATA 89SS6,23,89SS7,11,93SS1,91,93SS2,79,93SS3,68,93SS4,56
4910 DATA 93SS5,44,93SS6,33,93SS7,21,98SS1,101,98SS2,89,98SS3,78
4920 DATA 98SS4,66,98SS5,55,98SS6,43,98SS7,32,102SS1,111,102SS2,100
4930 DATA 102SS3,88,102SS4,77,102SS5,65,102SS6,54,102SS7,42
4940 DATA 107SS1,122,107SS2,110,107SS3,99,107SS4,87,107SS5,76,107SS6,64
4950 DATA 107SS7,53,115SS1,139,115SS2,128,115SS3,116,115SS4,105
4960 DATA 115SS5,93,115SS6,82,115SS7,70,124SS1,160,124SS2,149
4970 DATA 124SS3,137,124SS4,126,124SS5,114,124SS6,103,124SS7,91
4980 DATA 133SS1,186,133SS2,175,133SS3,163,133SS4,151,133SS5,140
4990 DATA 133SS6,128,133SS7,117
5000 '
5010 '           **** TABLE FOR SIT  -  MARRIED ****
5020 '                $00.00 - 133.00 GROSS PAY
5030 '
5040 DATA  34SM1,00,40SM1,03,42SM1,05,44SM1,06,46SM1,08,48SM1,10
5050 DATA 49SM1,11,52SM1,13,52SM2,02,54SM1,15,54SM2,04,56SM1,17
5060 DATA 56SM2,06,59SM1,20,59SM2,08,61SM1,22,61SM2,10,66SM1,28
5070 DATA 66SM2,17,66SM3,05,70SM1,39,70SM2,27,70SM3,16,70SM4,04
5080 DATA 75SM1,49,75SM2,38,75SM3,26,75SM4,14,75SM5,03,79SM1,59
5090 DATA 79SM2,48,79SM3,36,79SM4,25,79SM5,13,79SM6,02,84SM1,70
5100 DATA 84SM2,58,84SM3,47,84SM4,35,84SM5,24,84SM6,12,84SM7,01
5110 DATA 89SM1,80,89SM2,69,89SM3,57,89SM4,46,89SM5,34,89SM6,23
5120 DATA 89SM7,11,93SM1,91,93SM2,79,93SM3,68,93SM4,56,93SM5,44
5130 DATA 93SM6,33,93SM7,21,98SM1,101,98SM2,90,98SM3,78,98SM4,67
5140 DATA 98SM5,55,98SM6,44,98SM7,32,102SM1,113,102SM2,102,102SM3,90
5150 DATA 102SM4,78,102SM5,67,102SM6,55,102SM7,44,107SM1,125
5160 DATA 107SM2,113,107SM3,102,107SM4,90,107SM5,78,107SM6,67
5170 DATA 107SM7,55,115SM1,144,115SM2,133,115SM3,121,115SM4,110
5180 DATA 115SM5,98,115SM6,87,115SM7,75,124SM1,167,124SM2,156
5190 DATA 124SM3,144,124SM4,133,124SM5,121,124SM6,110,124SM7,98
5200 DATA 133SM1,199,133SM2,188,133SM3,176,133SM4,165,133SM5,153
5210 DATA 133SM6,142,133SM7,130
5220 DATA EOD,999
5230 END
```

PA3 PROGRAM

```
10 ' PROGRAM NAME "PA3"
20 ' MITS BASIC VERSION 4.0
30 ' PROGRAMMED BY:  BUD SHAMBURGER,  FEB 1977
                     #27 RED OAK DR
                     CONWAY, ARK  72032   501-327-3641
40 '
50 ' THIS PROGRAM RUNS THE WEEKLY, MONTHLY, QUARTERLY OR Y.T.D
60 ' PAYROLL REGISTERS.  THE INPUT TO THIS PROGRAM IS THE FILE(S)
70 ' CREATED WHEN COMPUTING THE PAYROLL PERIOD USING PROGRAM "PA2"
80 ' AND THE PAYROLL MASTER "PACURR".  "PACURR" IS USED AS A CHECK
90 ' LIST FROM WHICH TO PROCESS EMPLOYEES IN ALL TRANSACTIONS FILES.
100 ' IT ALSO CONTAINS SOME OF THE I.D. INFORMATIONS USED IN THE REPORTS.
110 ' THIS PROGRAM RECONSTRUCTS THE FILE NAME(S) BASED ON THE BEGIN-
120 ' ING AND ENDING DATES ENTERED FROM THE TERMINAL AT RUN TIME.
130 ' THIS PROGRAM IS USED FOR PRODUCING THE WEEKLY OR MONTHLY
140 ' REPORTS WHOSE TOTALS ARE ENTERED IN TO THE GENERAL LEDGER
150 ' ACCOUNTING PACKAGE.  THE GENERAL LEDGER ENTRIES ARE PRODUCED AS
160 ' THE LAST PAGE OF THE REPORT(S).  IT IS ALSO USED TO RUN THE
170 ' QUARTERLY REPORTS NECESSARY TO COMPLY WITH GOVERNMENT REPORTING
180 ' REQUIREMENTS.  THE Y.T.D. FEATURES OF THIS PROGRAM ARE USED
190 ' TO MAKE CERTAIN THAT ALL THE INDIVIDUAL PAYPERIOD FILES ARE
200 ' IN BALANCE WITH THE Y.T.D. BALANCES MAINTAINED ON THE PAYROLL
210 ' MASTER FILE(SEE "PA4" FOR MASTER FILE LISTINGS)
220 ' THE WEEKLY REPORT IS USED TO PREPARE (TYPEWRITTEN) THE EMPLOYEE
230 ' PAY CHECKS.  COMPUTER GENERATED PAYROLL CHECKS ARE NOT A PART OF
240 ' THIS PACKAGE, IT IS DESIGNED FOR A RELATIVELY SMALL NUMBER OF
250 ' EMPLOYEES.  IT IS CURRENTLY BE USED FOR 22 EMPLOYEES PER WEEK.
260 '
270 ' THE BASIC MACHINE REQUIREMENTS FOR THIS PROGRAM ARE THOSE AS
280 ' OUTLINED IN "PA1"
290 '
300 '*****************************************************************
310 '*****************************************************************
320 '
330 CLEAR 2500
340 EWT$="##,###.##"
350 EVT$="##,###.##-"
360 PC=1          'PAGE COUNTER
370 EIT$=EVT$+EVT$+EVT$+EVT$+EVT$+EVT$+EVT$+EWT$  ' EDIT WORD
380 REC=200                'PACURR STARTS AT 200+1
390 H1$="REGLR-PAY OV/TM-PAY GROSS-PAY  F I C A   F W H    S I T"
400 H2$="     DEDUCTS   NET-PAY"
410 PRINT "PAYROLL REGISTERS"
420 INPUT "ENTER -Y- TO MOUNT THE FILES";WY$
430 IF WY$<>"Y" THEN 450
440 UNLOAD 1:MOUNT 1
450 INPUT "ENTER - WEEKLY-,-MONTHLY-,QUARTERLY-,-YTD-";TY$
460 INPUT "ENTER PERIOD BEGINNING DATE AS MO-DY-YR";BDT$
470 ON ERROR GOTO 2640'       TRAP FOR NO FILE FOUND ERR
480 INPUT "ENTER PERIOD ENDING DATE AS MO-DY-YR";EDT$
490 OPEN"R",1,"PACURR",1   ' OPEN PAYROLL MASTER FILE
500 GOSUB 1640             'TO COMPUTE FIRST FILE NAME AND PUT IN N1$
510 GOSUB 1750             'TO COMPUTE LAST FILE NAME AND PUT IN N2$
520 GOSUB 2020             'TO PRINT PAGE HEADINGS
530 GOSUB 550   ' GET FIRST EMPLOYEE FROM MASTER FILE
540 GOTO 750
550 REC=REC+1
560 '
570 '*****************************************************************
580 '********** GET THE PAYROLL MASTER FILE "PACURR"
590 '********** THE PAYROLL MASTER IS USED AS A CHECK LIST TO CHECK
600 '********** EACH TRANSACTION FILE FOR ACTIVITY OF EACH EMPLOYEE
610 '*****************************************************************
620 '
630 GET #1,REC
640 FIELD #1,4 AS EMPD$,17 AS NAD$,36 AS B1$,9 AS SSD$,6 AS DTD$,
       3 AS RRD$,1 AS MSD$,1 AS EXD$,1 AS SXD$,49 AS B2D$,
       1 AS CDD$
650 IF MID$(EMPD$,1,3)="EOF" THEN 2790'  END OF MSTR FILE - TO EOJ ROUTINE
660 IF CDD$="*" THEN 550      'BAD MASTER FILE RECORD-SKIP
670 TDT$=MID$(EDT$,1,2)+MID$(EDT$,4,2)+MID$(EDT$,7,2)
680 IF CDD$="9"ANDTDT$<DTD$THEN 550' EMPLOYEE  TERMINATED PRIOR TO THIS REPORT
690 RETURN
700 '
710 '*****************************************************************
720 '********** OPEN TRANSACTION FILE AND INPUT DATA
730 '*****************************************************************
740 '
750 OPEN "I",2,N1$,1
760 IF EOF(2) THEN GOSUB 2150:OPEN "I",2,N1$,1:NF=0
770 INPUT #2,D$
780 EP$=MID$(D$,1,4)
790 XT$=MID$(D$,22,6)
800 RT$=MID$(D$,28,4)
810 DPD$=MID$(D$,127,1)
820 OV$=MID$(D$,32,4)
830 PR$=MID$(D$,36,6)+"."+MID$(D$,42,2) 'INSERT DECIMAL POINT
840 PO$=MID$(D$,44,6)+"."+MID$(D$,50,2)
850 GP$=MID$(D$,52,6)+"."+MID$(D$,58,2)
860 FI$=MID$(D$,60,6)+"."+MID$(D$,66,2)
870 FW$=MID$(D$,68,6)+"."+MID$(D$,74,2)
880 SI$=MID$(D$,76,6)+"."+MID$(D$,82,2)
890 OT$=MID$(D$,84,6)+"."+MID$(D$,90,2)
900 NT$=MID$(D$,92,6)+"."+MID$(D$,98,2)
910 PPR$=MID$(D$,100,3)
920 DE$=MID$(D$,127,1)
930 CD$=MID$(D$,128,1)
940 IF EMPD$<EP$ THEN 2330    'NOT IN THIS FILE-TRY NEXT FILE
950 IF EMPD$>EP$ THEN 760
960 '
970 '*****************************************************************
980 '********** ADD EMPLOYEE TOTALS TO REPORT COUNTERS
990 '*****************************************************************
1000 '
1010 L1#=VAL(PR$):F1#=F1#+L1#:T1#=T1#+L1#
1020 L2#=VAL(PO$):F2#=F2#+L2#:T2#=T2#+L2#
1030 L3#=VAL(GP$):F3#=F3#+L3#:T3#=T3#+L3#
1040 L4#=VAL(FI$):F4#=F4#+L4#:T4#=T4#+L4#
1050 L5#=VAL(FW$):F5#=F5#+L5#:T5#=T5#+L5#
1060 L6#=VAL(SI$):F6#=F6#+L6#:T6#=T6#+L6#
1070 L7#=VAL(OT$):F7#=F7#+L7#:T7#=T7#+L7#
1080 L8#=VAL(NT$):F8#=F8#+L8#:T8#=T8#+L8#
1090 '
1100 '*****************************************************************
1110 '********** ADD EMPLOYEE TO DEPARTMENT COUNTERS FOR GENERAL LEDGER
1120 '********** ACCOUNTING BREAK DOWN
1130 '*****************************************************************
1140 IF DED$="1" THEN G1#=G1#+L3#:GOTO 1260  'GEN MGR      7100
1150 IF DED$="2" THEN G2#=G2#+L3#:GOTO 1260  'DESK CLERKS  7101
1160 IF DED$="3" THEN G3#=G3#+L3#:GOTO 1260  'HOUSEKEEPER  7102
1170 IF DED$="4" THEN G4#=G4#+L3#:GOTO 1260  'LINEN BOYS   7103
1180 IF DED$="5" THEN G5#=G5#+L3#:GOTO 1260  'MAIDS        7104
1190 IF DED$="6" THEN G6#=G6#+L3#:GOTO 1260  'LAUNDRY      7105
1200 IF DED$="7" THEN G7#=G7#+L3# ELSE STOP 'REPAIRS&MAIN 7602
1210 '
1220 '*****************************************************************
1230 '********** ADD EMPLOYEE TO  REST OF GENERAL LEDGER ACCOUNTING
1240 '********** BREAK DOWN COUNTERS
1250 '*****************************************************************
1260 H1#=H1#+L8#:H6#=H6#+L8#        'BANK         1110
1270 H2#=H2#+L6#:H6#=H6#+L6#        'SIT          2109
```

```
1280 H3#=H3#+L5#:H6#=H6#+L5#        'FWH          2110
1290 H4#=H4#+L4#:H6#=H6#+L4#        'FICA         2111
1300 H5#=H5#+L7#:H6#=H6#+L7#        'DEDUCTS      ????
1310 IF TY$="WEEKLY" THEN 2360
1320 IF S1=0 THEN 2360             'PRINT EMP I.D. INFO
1330 GOSUB 2460
1340 '
1350 '**************************************************************
1360 '********** PRINT REPORT LINE OF EARNINGS DATA
1370 '**************************************************************
1380 '
1390 LPRINT USING EIT$;L1#,L2#,L3#,L4#,L5#,L6#,L7#,L8#
1400 GOSUB 2560
1410 IF TY$="WEEKLY" THEN LPRINT:GOSUB 2560
1420 IF TY$="WEEKLY" THEN GOSUB 550:GOTO 760
1430 GOSUB 2150
1440 OPEN "I",2,N1$,1:NF=0
1450 GOTO 760                       'GET NEXT MSTR RECORD
1460 '
1470 '**************************************************************
1480 '********** PRINT EMPLOYEE TOTALS
1490 '*****************************************************************
1500 '
1510 '
1520 LPRINT USING EIT$;T1#,T2#,T3#,T4#,T5#,T6#,T7#,T8#  'PRINT EMP# TOTALS
1530 GOSUB 2560
1540 T1#=0:T2#=0:T3#=0:T4#=0:T5#=0:T6#=0:T7#=0:T8#=0
1550 S1=0                          'RESET NEW EMP SWITCH
1560 IF TY$="WEEKLY" THEN 2810
1570 LPRINT:GOSUB 2560
1580 GOSUB 1640:GOTO 530
1590 '
1600 '***************************************************************
1610 '********** COMPUTE FIRST FILE NAME FOR PAYROLL PERIOD DATA
1620 '**************************************************************
1630 '
1640 IF MID$(BDT$,4,2)<="07" THEN 1810  'PERIOD 1 FIRST FILE NAME
1650 IF MID$(BDT$,4,2)<="14" THEN 1830  'PERIOD 2 FIRST FILE NAME
1660 IF MID$(BDT$,4,2)<="21" THEN 1850  'PERIOD 3 FIRST FILE NAME
1670 IF MID$(BDT$,4,2)<="28" THEN 1870  'PERIOD 4 FIRST FILE NAME
1680 N1$="PA"+MID$(BDT$,1,2)+"5"+MID$(BDT$,7,2)  'PERIOD 5 FIRST FILE
1690 RETURN
1700 '
1710 '***************************************************************
1720 '********** COMPUTE LAST FILE NAME FOR PAYROLL PERIOD DATA
1730 '***************************************************************
1740 '
1750 IF MID$(EDT$,4,2)<="07" THEN 1890  'PERIOD 1 LAST FILE NAME
1760 IF MID$(EDT$,4,2)<="14" THEN 1910  'PERIOD 2 LAST FILE NAME
1770 IF MID$(EDT$,4,2)<="21" THEN 1930  'PERIOD 3 LAST FILE NAME
1780 IF MID$(EDT$,4,2)<="28" THEN 1950  'PERIOD 4 LAST FILE NAME
1790 N2$="PA"+MID$(EDT$,1,2)+"5"+MID$(EDT$,7,2) 'PERIOD 5 LAST FILE NAME
1800 RETURN
1810 N1$="PA"+MID$(BDT$,1,2)+"1"+MID$(BDT$,7,2)
1820 GOTO 1690
1830 N1$="PA"+MID$(BDT$,1,2)+"2"+MID$(BDT$,7,2)
1840 GOTO 1690
1850 N1$="PA"+MID$(BDT$,1,2)+"3"+MID$(BDT$,7,2)
1860 GOTO 1690
1870 N1$="PA"+MID$(BDT$,1,2)+"4"+MID$(BDT$,7,2)
1880 GOTO 1690
1890 N2$="PA"+MID$(EDT$,1,2)+"1"+MID$(EDT$,7,2)
1900 GOTO 1800
1910 N2$="PA"+MID$(EDT$,1,2)+"2"+MID$(EDT$,7,2)
1920 GOTO 1800
1930 N2$="PA"+MID$(EDT$,1,2)+"3"+MID$(EDT$,7,2)
1940 GOTO 1800
1950 N2$="PA"+MID$(EDT$,1,2)+"4"+MID$(EDT$,7,2)
1960 GOTO 1800
1970 '
1980 '**************************************************************
1990 '********** PRINT ROUTINE FOR PAGE HEADINGS
2000 '**************************************************************
2010 '
2020 LPRINT SPC(25);"CONWAY RI INC":LPRINT
2030 L=LEN(TY$):LPRINT SPC(29-L);TY$;" PAYROLL REGISTER"
2040 LPRINT SPC(23);"PERIOD ENDING ";EDT$;SPC(15);"PAGE ";PC
2050 LPRINT:LPRINT STRING$(79,45)
2060 LPRINT H1$;H2$
2070 LPRINT STRING$(79,45):LPRINT
2080 LC=9
2090 RETURN
2100 '
2110 '**************************************************************
2120 '********** COMPUTE NEXT FILE NAME IN SERIES
2130 '**************************************************************
2140 '
2150 X$=MID$(N1$,5,1)          'COMPUTE NEXT FILE NAME
2160 X=VAL(X$)
2170 X=X+1:X$=STR$(X):X$=MID$(X$,2,1)
2180 IF X>5 THEN 2260
2190 N3$=N1$
2200 MID$(N3$,5,1)=X$
2210 CLOSE 2
2220 IF N3$>N2$ AND T3#<1 THEN GOSUB 1640:GOTO 530
2230 IF N3$>N2$ THEN 1520
2240 N1$=N3$
2250 RETURN
2260 Y$=MID$(N1$,3,2)
2270 Y=VAL(Y$):Y=Y+1
2280 IF Y>12 THEN PRINT "ERR IN FILE NAME":STOP
2290 Y$=STR$(Y):L=LEN(Y$):IF L=3 THEN Y$=MID$(Y$,L-1,L-2):GOTO 2310
2300 Y$="0"+MID$(Y$,2,1)
2310 N3$="PA"+Y$+"1"+MID$(N1$,6,2)' LOAD NEXT FILE NAME
2320 GOTO 2210
2330 IF TY$="WEEKLY" THEN GOSUB 550:GOTO 940
2340 GOSUB 2150:OPEN "I",2,N1$,1:NF=0
2350 GOTO 760               'INPUT NEXT FILE
2360 S1=1                   'TURN NEW EMP SW ON FOR PRINTING EMP I.D. INFO
2370 '
2380 '**************************************************************
2390 '********** PRINT EMPLOYEE I.D. INFORMATION
2400 '****************************************************************
2410 '
2420 LPRINT:GOSUB 2560
2430 LPRINT EMPD$;" ";NAD$;" ";SSD$;" ";RRD$;" ";MSD$;EXD$;SXD$;DPD$
2440 GOSUB 2560             'CHECK FOR PAGE OVERFLOW
2450 GOTO 1330                       'CONTINUE REPORT
2460 LPRINT "MODYYR RGHR OTHR RTE"
2470 GOSUB 2560             'CHECK FOR PAGE OVERFLOW
2480 LPRINT XT$;" ";RT$;" ";OV$;" ";PPR$   'PAY PERIOD I.D. INFO
2490 GOSUB 2560             'CHECK FOR PAGE OVERFLOW
2500 RETURN
2510 '
2520 '**************************************************************
2530 '********** PAGE OVERFLOW ROUTINE
2540 '**************************************************************
2550 '
2560 LC=LC+1          '***** OVERFLOW ROUTINE *****
2570 IFLC>55THENPC=PC+1:FORI=1TO10:LPRINT:NEXTI:GOSUB2020'PRINT HEADINGS
2580 RETURN
2590 '
2600 '**************************************************************
2610 '********** ERROR TRAPPING ROUTINE FOR MONTHS WITH OUT 5TH PAYPERIOD
2620 '**************************************************************
2630 '
2640 IF ERR=53 AND ERL=760 THEN 2700
2650 IF ERR=53 AND ERL=2720 THEN 2700
2660 IF ERR=53 AND ERL=2340 THEN 2700
2670 IF ERR=53 AND ERL=1440 THEN 2700
2680 IF ERR=53 AND ERL=760 THEN 2700
2690 ON ERROR GOTO 0
2700 NF=NF+1
2710 IF NF>1 THEN PRINT "2 CONSEC NO-FILES-FOUND ERR":STOP
2720 GOSUB 2150
2730 RESUME   'RESET ERROR TRAPPING AND RETURN TO ERROR LOCATION
2740 '
```

```
2750 '*****************************************************************
2760 '********** EOJ ROUTINE - PRINT FINAL TOTALS AND ACCOUNTING ENTRIES
2770 '*****************************************************************
2780
2790 LPRINT
2800 LPRINT USING EIT$;F1#,F2#,F3#,F4#,F5#,F6#,F7#,F8# 'PRINT FINAL TOTALS
2810 LPRINT
2820 LPRINT SPC(18);"JOURNAL  VOUCHER"
2830 LPRINT
2840 LPRINT SPC(6);"D E B I T S";SPC(17)"C R E D I T S"
2850 LPRINT
2860 Q1$="7100 GEN MANAGER "
2870 Q2$="7101 DESK CLERKS "
2880 Q3$="7102 HOUSEKEEPER "
2890 Q4$="7103 LINEN BOYS  "
2900 Q5$="7104 MAIDS       "
2910 Q6$="7105 LAUNDRY     "
2920 Q7$="7602 REPAIRS&MAIN"
2930 Q8$="        TOTAL    "
2940 V1$="1110 BANK    "
2950 V2$="2109 SIT     "
2960 V3$="2110 FWH     "
2970 V4$="2111 FICA    "
2980 V5$="???? DEDUCTS "
2990 V6$="        TOTAL "
3000 EJT$=Q1$+EVT$+"    "+V1$+EVT$
3010 LPRINT USING EJT$;G1#,H1#
3020 EJT$=Q2$+EVT$+"    "+V2$+EVT$
3030 LPRINT USING EJT$;G2#,H2#
3040 EJT$=Q3$+EVT$+"    "+V3$+EVT$
3050 LPRINT USING EJT$;G3#,H3#
3060 EJT$=Q4$+EVT$+"    "+V4$+EVT$
3070 LPRINT USING EJT$;G4#,H4#
3080 EJT$=Q5$+EVT$+"    "+V5$+EVT$
3090 LPRINT USING EJT$;G5#,H5#
3100 LPRINT Q6$ USING EVT$;G6#
3110 LPRINT Q7$ USING EVT$;G7#
3120 EJT$=Q8$+EVT$+"    "+V6$+EVT$
3130 LPRINT USING EJT$;F3#,H6#
3140 PRINT "EOJ"
3150 END
```

PA4 PROGRAM

```
10 ' PROGRAM NAME "PA4"
20 ' MITS BASIC VERSION 4.0
30 ' PROGRANED BY: BUD SHAMBURGER    FEB 1977
                   #27 RED OAK DR
                   CONWAY, ARK  72032    501-327-3641
40 '
50 ' A PROGRAM TO LIST THE PAYROLL MASTER FILE "PACURR" SHOWING ALL
60 ' THE NECESSARY DATA FOR EACH EMPLOYEE.  THE MASTER FILE RESIDES
70 ' ON DISK DRIVE 1.  THE TOTALS FROM THIS RUN SHOULD EQUAL THE TOTALS
80 ' OBTAINED WHEN PROGRAM "PA3" IS USED TO RUN PAYROLL TRANSACTION
90 ' FILES USING THE Y.T.D.FEATURE.
100 '
110 ' MINMUM HARDWARE REQUIREMENTS ARE THOSE LISTED IN "PA1"
120 '
130 '*******************************************************************
140 '*******************************************************************
150 '
160 CLEAR 1500
170 PRINT "PAYROLL MSTR YTD REPORT"
180 INPUT "ENTER PERIOD ENDING DATE AS MO-DY-YR";DT$
190 INPUT "ENTER -Y- TO MOUNT FILE";WY$
200 IF WY$<>"Y" THEN 220
210 UNLOAD 1:MOUNT 1
220 OPEN "R",1,"PACURR",1
230 EVT$="##,###.##-"  ' EDIT WORD
240 EWT$="##,###.##"
250 EIT$=EVT$+EVT$+EVT$+EVT$+EVT$+EWT$ ' EDIT WORD
260 B$=" "
270 REC=200                              ' FILE COUNTER
280 PC=1                       ' PAGE COUNTER
290 GOSUB 740                  ' TO PRINT PAGE HEADINGS
300 '
310 '*********** GET PAYROLL MASTER FILE ************
320 '
330 REC=REC+1
340 GET #1,REC
350 FIELD #1,4 AS EMPD$,17 AS NAD$,35 AS B1D$,1 AS DPD$,9 AS SOCD$,
         6 AS B2D$,3 AS CRTD$,3 AS MEXD$,8 AS GPD$,8 AS FID$,
         8 AS FWD$,8 AS SID$,8 AS DED$,8 AS NTD$,1 AS B3D$,
         1 AS CDD$
360 IF MID$(EMPD$,1,3)="EOF" THEN 990' TO EOJ ROUTINE
370 IF CDD$="*" THEN 330                 'BAD DISK RECORD-BYPASS
380 LPRINT EMPD$;" ";NAD$       'PRINT EMPLOYEE I.D.
390 GOSUB 910                   'CHECK FOR PAGE OVERFLOW
400 '
410 '****************** LOAD PRINT AREA AND ADD TO COUNTERS*********
420 '
430 L1$=MID$(GPD$,1,6)+"."+MID$(GPD$,7,2) ' INSERT DECIMAL POINTS
440 L2$=MID$(FID$,1,6)+"."+MID$(FID$,7,2)
450 L3$=MID$(FWD$,1,6)+"."+MID$(FWD$,7,2)
460 L4$=MID$(SID$,1,6)+"."+MID$(SID$,7,2)
470 L5$=MID$(DED$,1,6)+"."+MID$(DED$,7,2)
480 L6$=MID$(NTD$,1,6)+"."+MID$(NTD$,7,2)
490 L1#=VAL(L1$)                          ' LOAD PRINT LINE DATA
500 L2#=VAL(L2$)
510 L3#=VAL(L3$)
520 L4#=VAL(L4$)
530 L5#=VAL(L5$)
540 L6#=VAL(L6$)
550 T1#=T1#+L1#                           ' ADD TO REPORT TOTALS
560 T2#=T2#+L2#
570 T3#=T3#+L3#
580 T4#=T4#+L4#
590 T5#=T5#+L5#
600. T6#=T6#+L6#
610 '
620 '******** PRINT REPORT LINE ***************
630 '
640 LPRINTSOCD$;B$;CRTD$;B$;MEXD$;DPD$;B$USINGEIT$;L1#,L2#,L3#,L4#,L5#,L6#
650 GOSUB 910                            'CHECK FOR PAGE OVERFLOW
660 LPRINT
670 GOSUB 910
680 GOTO 330                              ' GET NEXT EMPLOYEE
690 '
700 '*****************************************************************
710 '******** ROUTINE TO PRINT PAGE HEADINGS
720 '*****************************************************************
730 '
740 LPRINT SPC(25);"CONWAY RI INC"    'PAGE HEADING ROUTINE
750 LPRINT:LPRINT SPC(24);"PAYROLL MASTER YTD"
760 LPRINT SPC(22);"PERIOD ENDING ";DT$;SPC(15);"PAGE ";PC
770 LPRINT
780 H1$="  SOC-SEC CRT MEX D GROSS-PAY  F I C A    F W H     S I T"
790 H2$="     DEDUCTS   NET-PAY"
800 LPRINT STRING$(79,45)
810 LPRINT H1$;H2$
820 LPRINT STRING$(79,45)
830 LPRINT
840 LC=9
850 RETURN
860 '
870 '*****************************************************************
880 '******** ROUTINE TO CHECK FOR PAGE OVERFLOW
890 '*****************************************************************
900 '
910 LC=LC+1
920 IF LC>55 THENPC=PC+1:FORI=1TO10:LPRINT:NEXTI:GOSUB740'PRINT HEADINGS
930 RETURN
940 '
```

A Special Planned for August Issue ASTRONOMY

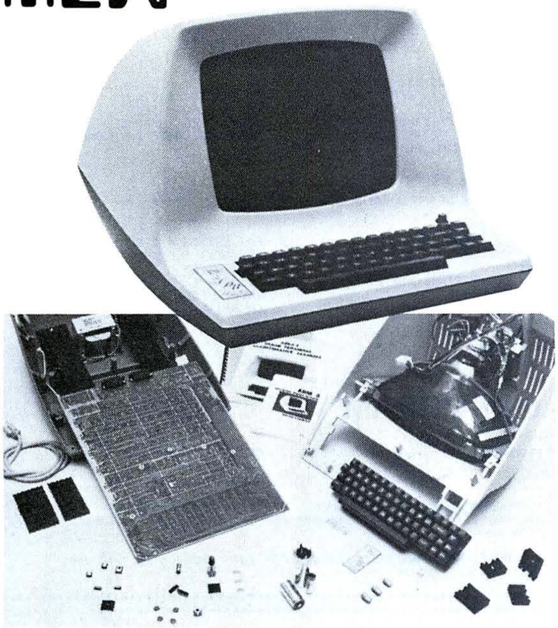
INTERFACE AGE plans to take you out of the August doldrums and lift you up into the starry sky. We are seeking both professional- and amateur-authored articles on microcomputer applications in astronomy. Text should not exceed 10 double-spaced typewritten pages. Flow charts, schematics and listings should accompany text. Computer listings must be printed with a new ribbon to assure a crisp copy when reduced. Deadline for submittals is June 24, 1977. The August issue will have an added attraction for sky-buffs. Roger Garrett has written the ultimate space game in which all functions of the Enterprise are simulated: navigation, communications, inter- and intra-ship transportation and all manners of tactical maneuvers of enemy and Federation craft. In this game several people can play, each assuming the role of navigator, engineer and helmsman. It is written in structured pseudo-code and completely documented. Have fun playing this game.

SYNCHRO-SOUND Enterprises
Your Small Computer Department Store

One-stop shopping for Hardware and Software

Compare our PRICES, PRODUCTS, QUALITY, DELIVERY, SERVICE . . . we carry everything you need in small computers, terminals, printers, monitors, keyboards, accessories. We'll meet or beat competitive prices on everything we sell!

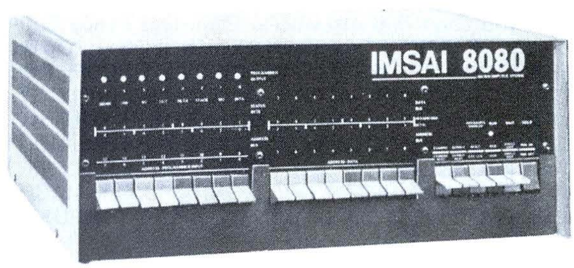
NEW LEAR SIEGLER ADM-3A TERMINAL



- Full addressable cursor.
- Display Format— Standard: 1920 characters, displayed in 24 lines of 80 characters per line.
- Communications Rates— 75 to 19,200 baud (switch selectable).
- Computer Interfaces— EIA standard RS232C and 20mA current-loop (switch selectable).

ADM-3A Kit. **$839.95**
ADM-3A Assembled. **1079.95**
Lower Case Option. . . . **89.00**

IMSAI 8080 MICROCOMPUTER



Powerful • Easy to use • Low cost

With 22 Slot Mother Board. . . **$619.95**
With Z-80 CPU. **849.95**

OKIDATA Model 110 Line Printer

- **110 CPS dot matrix**

Friction Feed. **$1099.00**
Tractor Feed. **1229.00**
RS 232C Serial Interface. . . **250.00**

We carry a full line of the following: TDL, OAE, Processor Tech., Hayden, Tarbell, IMSAI, Cromemco, Compucolor, Icom, Lear Siegler, Okidata, DEC, Javelin, Teletype, North Star, Heuristics, Peripheral Vision, TRW. Same day delivery and shipping on most items. Full, modern repair facilities on premises for complete servicing of everything we sell.

SSE

SYNCHRO-SOUND Enterprises
The Computer People
193-25 Jamaica Avenue, Jamaica, New York 11423 • 212/468-7067

Hours 9-4 daily and Saturday

Visit our new showroom . . . working units on display

Dept. I

BankAmericard • Master Charge

☐ Please send me further information on: (list items)

____

______________________________ Price List ☐

Name ______________________________

Address ______________________________

City ______________ State ______________ Zip ________

CIRCLE INQUIRY NO. 92

```
950 '*****************************************************************
960 '******** PRINT REPORT TOTALS AND EOJ
970 '*****************************************************************
980 '
990 LPRINT
1000 LPRINT SPC(10);"TOTAL";SPC(5);USING EIT$;T1#,T2#,T3#,T4#,T5#,T6#
1010 PRINT "EOJ"
1020 END
```

PA5 PROGRAM

```
10 ' PROGRAM NAME "PA5"
20 ' PROGRAMMED BY:  BUD SHAMBURGER    FEB 1977
                     #27 RED OAK DR
                     CONWAY, ARK  72032    501-327-3641
30 '
40 ' A PROGRAM TO RE-INITIALIZE THE PAYROLL MASTER "PACURR" AT
50 ' THE END OF THE CALANDER YEAR.  IT CONSTRUCTS A NEW "PACURR"
60 ' AND DELETES BAD DISK RECORDS ('*' IN 128) AND DELETES EMPLOYEES
70 ' TERMINATED DURING THE LAST CALANDER YEAR ('9' IN 128). OLD "PACURR"
80 ' RESIDES ON DISK DRIVE 1 AND NEW "PACURR" RESIDES ON DISK DRIVE 0
90 '
100 ' THE BASIC HARDWARE REQUIREMENTS FOR THIS PROGRAM ARE THE SAME
110 ' AS THOSE LISTED IN "PA1".
120 '
130 '*******************************************************************
140 '*******************************************************************
150 '
160 CLEAR 1500
170 PRINT "INITIALIZE NEW PAYROLL MASTER"
180 PRINT "OLD FILE ON DR1 - NEW FILE ON DR0"
190 INPUT "ENTER -Y- TO MOUNT FILES";WY$
200 IF WY$<>"Y" THEN 250
210 UNLOAD 0,1:MOUNT 0,1
220 '
230 '********** OPEN BOTH FILES **********
240 '
250 OPEN "R",1,"PACURR",1
260 OPEN "R",2,"PACURR",0
270 REC=200:DSK=200                       ' FILE COUNTERS
280 REC=REC+1
290 '
300 '********** GET OLD PAYROLL MASTER **********
310 '
320 GET #1,REC
330 FIELD #1,128 AS D$
340 IF MID$(D$,1,3)="EOF" THEN 470      ' GO SET EOJ SWITCH
350 IF MID$(D$,128,1)="*" THEN 280      ' BAD RECORD - SKIP
360 IF MID$(D$,128,1)="9" THEN 280      ' TERMINATED EMPLOYEE - SKIP
370 A$=MID$(D$,1,78)+SPACE$(49)+"1"     ' TRANSFER BASIC DATA ONLY
380 FIELD #2,128 AS DO$
390 LSET DO$=A$
400 DSK=DSK+1
410 '
420 '********** WRITE OUT THE NEW PAYROLL MASTER **********
430 '
440 PUT #2,DSK
450 IF SW=1 THEN 510                      ' EOJ SWITCH = 1 GO TO EOJ ROUTINE
460 GOTO 280                              ' GET NEXT OLD MASTER
470 SW=1                                  ' EOJ SWITCH
480 RSET DO$=STRING$(128,0)               ' CLEAR OUT PUT AREA TO BLANKS
490 LSET DO$="EOF"                        ' INSERT EOF IN LAST RECORD
500 GOTO 400                              ' GO WRITE OUT EOF
510 CLOSE
520 PRINT "EOF IN ";DSK
530 PRINT "EOJ"
540 END
```

PA6 PROGRAM

```
10 ' PROGRAM NAME "PA6"
20 ' PROGRAMMED BY:  BUD SHAMBURGER     FEB 1977
                     #27 RED OAK DR
                     CONWAY, ARK  72032     501-327-3641
30 '
40 ' A PROGRAM TO RUN ADDRESS LABELS FROM THE PAYROLL MASTER "PACURR"
50 ' THE ADDRESS LABELS ARE USED FOR MAILING EMPLOYEE W-2 FORMS AT
60 ' YEAR END.
70 '
80 ' THE BASIC HARDWARE REQUIREMENTS FOR THIS PROGRAM ARE THE SAME
90 ' AS THOSE LISTED IN "PA1"
100 '
110 '*******************************************************************
120 '*******************************************************************
130 '
140 CLEAR 500
150 PRINT "PAYROLL MSTR ADDR LABELS" .
160 INPUT "ENTER -Y- TO MOUNT FILE";WY$
170 IF WY$<>"Y" THEN 220
180 UNLOAD 1:MOUNT 1
190 '
200 '********** GET THE PAYROLL MASTER ***********
210 '
220 OPEN "R",1,"PACURR",1
230 REC=200
240 REC=REC+1
250 GET #1,REC
260 FIELD #1,4 AS EMPD$,17 AS N1$,17 AS N2$,13 AS N3$,5 AS Z$,
          71 AS B$,1 AS CD$
270 IF CD$="*" THEN 240                  'BAD RECORD - SKIP
280 IF MID$(EMPD$,1,3)="EOF" THEN 390   ' GO TO EOJ ROUTINE
290 '
300 '********** PRINT EMPLOYEE I.D. INFO ********
310 '
320 LPRINT EMPD$;" ";MID$(B$,1,1);" ";MID$(B$,2,9);" ";MID$(B$,17,3);" ";
        MID$(B$,20,3)
330 LPRINT
340 LPRINT N1$                  ' PRINT EMPLOYEE N & A
350 LPRINT N2$
360 LPRINT N3$;" ";Z$
370 LPRINT:LPRINT:LPRINT:LPRINT
380 GOTO 240                    ' GET NEXT EMPLOYEE FROM MASTER FILE
390 PRINT "EOJ"
400 END
```

COPRAN PROGRAM

```
10 ' PROGRAM NAME "COPRAN"
20 ' MITS BASIC VERSION 4.0
30 ' PROGRAMMED BY:  BUD SHAMBURGER     JAN 1977
                     #27 RED OAK DR
                     CONWAY, ARK  72032     501-327-3641
40 '
50 ' A GENERAL PURPOSE UTILITY PROGRAM FOR COPYING RANDOM DATA FILES.
60 ' FILE NAMES, FILE NUMBERS AND DISK DRIVE NUMBERS ARE ENTERED FROM
70 ' THE TERMINAL. FILE BOUNDARIES ARE ALSO ENTERED FROM THE TERMINAL.
80 ' BOTH FILES CAN RESIDE ON THE SAME DISK DRIVE PROVIDED THEIR NAMES
90 ' ARE DIFFERENT.
100 '
110 '*******************************************************************
120 '*******************************************************************
130 '
140 CLEAR 500
150 PRINT "COPY * BASIC-RANDOM-FILES *"
160 PRINT
170 LET R$="R"
180 LET S=1
190 LET Q=2
200 INPUT "ENTER -INPUT- FILE NAME";I$
210 INPUT "ENTER -OUTPUT- FILE NAME";O$
220 INPUT "ENTER -INPUT- DR#";X
```

```
230 INPUT "ENTER -OUTPUT- DR#";Y
240 INPUT "ENTER -INPUT- BEG REC#";T
250 INPUT "ENTER -INPUT- END REC#";U
260 INPUT "ENTER -OUTPUT- BEG REC#";V
270 INPUT "ENTER -OUTPUT- END REC#";W
280 INPUT "TO MOUNT THE FILES ENTER -Y-";XY$
290 IF XY$<>"Y" THEN 320
300 IF X=Y THEN UNLOAD X:MOUNT X:GOTO 320
310 UNLOAD X,Y:MOUNT X,Y
320 LET ZT=U-T
330 LET ZV=W-V
340 IF X<>0 AND X<>1 THEN 570
350 IF Y<>0 AND Y<>1 THEN 570
360 IF ZT<>ZV THEN 590
370 OPEN R$,S,I$,X
380 OPEN R$,Q,O$,Y
390 GOSUB 540
400 IF T>U THEN 610
410 GET #1,T
420 FIELD #1,128 AS A$
430 LET C$=A$
440 FIELD #2,128 AS B$
450 RSET B$=C$
460 PUT #2,V
470 IF CT=11 THEN GOSUB 540
480 PRINT USING "####  ";X;T
490 PRINT USING "####  ";Y;V
500 LET CT=CT+1
510 LET T=T+1
520 LET V=V+1
530 GOTO 400
540 LET CT=0
550 PRINT " DR#  REC#"
560 RETURN
570 PRINT "ERROR IN DR#"
580 GOTO 220
590 PRINT "INPUT AREA & OUTPUT AREA UNEQUAL"
600 GOTO 240
610 CLOSE S,Q
620 PRINT "END OF COPY"
630 END
```

GETPUT PROGRAM

```
10 ' PROGRAM NAME "GETPUT"
20 ' PROGRAMMED BY:   BUD SHAMBURGER      JAN 1977
                      #27 RED OAK DR
                      CONWAY, ARK  72032     501-327-3641
30 '
40 ' A GENERAL PURPOSE UTILITY PROGRAM FOR DUMPING A RANDOM FILE
50 ' ON THE TERMINAL, EXAMINING ITS CONTENTS, AND ALTERING
60 ' IT BY TYPING IN THE LIMITS OF THE DESIRED FIELD
70 ' AND THEN ENTERING THE NEW DATA.  THE NEW RECORD IS THEN DUMP ON
80 ' THE TERMINAL FOR VISUAL INSPECTION.
90 ' AND ENTIRE DISK RECORD CAN BE CREATED USING THIS PROGRAM OR AS
100 ' LITTLE AS ONE CHARACTER CAN BE ENTERED OR CHANGED.
110 ' EACH POSITION IN THE 128 CHARACTER RECORD IS IDENTIFIED JUST
120 ' ABOVE ITS PRINT LOCATION.
130 '
140 '******************************************************************
150 '******************************************************************
160 '
170 CLEAR 500
180 BLK$="                    "
190 INPUT "ENTER FILE NAME";N$
200 INPUT "FILE NUMBER";F
210 INPUT "DRIVE NUMBER";D
220 INPUT "DO YOU WANT THE FILE MOUNTED -Y- FOR YES";Y$
230 IF Y$="Y" THEN UNLOAD D:MOUNT D
240 R$="R"
250 OPEN R$,F,N$,D
260 FIELD F,128 AS A$
270 LET C=1
280 INPUT "ENTER ADDR";C
290 GET F,C
300 A1$="1...5....0....5....0....5....0....5....0"
310 A2$="         1    1    2    2    3    3    4"
320 A3$="....5....0....5....0....5....0....5....0
330 A4$="    4    5    5    6    6    7    7    8"
340 A5$="....5..8"
350 A6$="    8    9    9    0    0    1    1    2"
360 A7$="    2  2"
370 PRINT A2$;A4$
380 PRINT A1$;A3$
390 PRINT MID$(A$,1,80)
400 PRINT A6$;A7$
410 PRINT A3$;A5$
420 PRINT MID$(A$,81,128)
430 INPUT "ENTER FIELD LIMITS AS XXX-XXX";B1$
440 B2$=MID$(B1$,1,3):B2=VAL(B2$)
450 B3$=MID$(B1$,5,3):B3=VAL(B3$)
460 K=B3-B2+1
470 IF K>128 THEN PRINT "FIELD SIZE ERROR":GOTO 430
480 PRINT "ENTER NEW DATA"
490 INPUT B$
500 C$=A$
510 MID$(C$,B2,K)=B$
520 LSET A$=C$
530 PUT F,C
540 PRINT A2$;A4$
550 PRINT A1$;A3$
560 PRINT MID$(C$,1,80)
570 PRINT A6$;A7$
580 PRINT A3$;A5$
590 PRINT MID$(C$,81,128)
600 GOTO 270
610 END
```

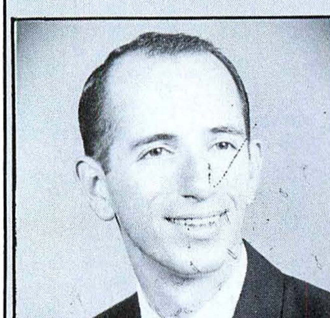
TVDUMPR PROGRAM

```
10 ' PROGRAM NAME "TVDUMPR"
20 ' PROGRAMMED BY:   BUD SHAMBURGER    JAN 1977
                      #27 RED OAK DR
                      CONWAY, ARK  72032
30 '
40 ' A GENERAL PURPOSE UTILITY PROGRAM TO DUMP A RANDOM FILE
50 ' ON THE TERMINAL AND LINE PRINTER.  PROVIDES A QUICK AND EASY
60 ' METHOD OF LOCATING THE ADDRESS OF A RECORD IN A RANDOM FILE
70 ' AND EXAMINING ITS CONTENTS.   DUMPS THE FULL 128 POSITION RECORD
80 ' WITH THE FIRST LINE BEING 79 CHARACTERS LONG AND THE BALANCE
90 ' APPEARING ON THE SECOND LINE.
100 '
110 '******************************************************************
120 '******************************************************************
130 '
140 CLEAR 500
150 LET R$="R"
160 INPUT "ENTER FILE NAME";I$
170 INPUT "ENTER FILE NUMBER";S
180 INPUT "ENTER DRIVE NUMBER";T
190 INPUT "DO YOU WANT THE FILE MOUNTED-Y-";WY$
200 IF WY$<>"Y" THEN 230
210 UNLOAD T
220 MOUNT T
230 IF T<0 OR T>1 THEN 380
240 IF S<1 OR S>15 THEN 390
250 OPEN R$,S,I$,T
260 FIELD #1,128 AS A$
270 INPUT "ENTER ADDR";C
280 IF C=9999 THEN 160
290 IF C<1 OR C>2038 THEN 400
300 GET S,C
```

```
310 PRINT C
320 PRINT MID$(A$,1,79)
330 PRINT MID$(A$,80,49)
340 LPRINT C
350 LPRINT MID$(A$,1,79)
360 LPRINT MID$(A$,80,49)
370 GOTO 270
380 PRINT "DR# ERROR":GOTO 180
390 PRINT "ERROR IN FILE #":GOTO 170
400 PRINT "ADDRESS ERROR":GOTO 270
410 END
```

SORTUT PROGRAM

```
10 REM: PROGRAM: "SORTUT"
20 REM: MITS BASIC VERSION 4.0
30 REM: PROGRAMED BY: BUD SHAMBURGER,  JAN 1977
40 REM:               #27 RED OAK DR.
50 REM:               CONWAY, ARK 72032   501-327-3641
60 REM:
70 REM: THIS PROGRAM IS CURRENTLY BEING RUN ON THE FOLLOWING SYSTEM:
         A. ALTAIR 8800 B,64K,SIO,PIO,PROM BOOTSTRAP LOADER
         B. 2 ALTAIR DISK DRIVES
         C. 1 ADM3K
         D. 1 OKIDATA 110 LINE PRINTER
80 REM
90 REM: A GENERAL PURPOSE NUMERIC UTILITY SORT PROGRAM DEVELOPED FOR
100 REM: RANDOM FILES ONLY - A TAG SORT WHICH CREATES A SORTED COPY OF THE
110 REM: UNSORTED DATA FILE. THE DATA FILE MAY BE BLOCKED OR UNBLOCKED
120 REM: RECORDS AS SPECIFIED ANSWERS TO THE PROGRAMS INPUT STATEMENTS.
130 REM: PROGRESS OF THE SORT IS MONITORED ON BOTH THE TERMINAL AND
140 REM: LINE PRINTER.  FOR SYSTEMS USING MITS BASIC VER 3.4 OR 4.0
150 REM: WITHOUT A LINE PRINTER MAY LEAVE THE LPRINT IN THE PROGRAM IF THEY
160 REM: SO DESIRE.  MITS BASIC WILL IGNORE THEM.
170 REM: SORTS A RANDOM FILE OF -N- RECORDS(SEE LINES 580-590)
180 REM: TOTAL FILE SIZE = 8 * NUMBER OF RECORDS DIMINSIONED IN
                  LINE 580 + 4 * NUMBER OF RECORDS DIMINISIONED
                  IN LINE 590
190 REM: MAXIMUM SORT FIELD LENGTH = 16 POSITIONS
200 REM: FOR UNBLOCKED RECORDS THE BLOCKING FACTOR = "1"
210 REM: MAXIMUM FILE SIZE - 64K MACHINE = APPROX 3,000 RECORDS
                  - 48K MACHINE = APPROX 1,750 RECORDS
                  - 32K MACHINE = APPROX 750 RECORDS
220 REM: EOF - MUST BE IN POSITIONS 1-3 OF THE LAST RECORD TO
230 REM:       STOP THE INPUT OF DATA TO THE SORT
240 REM: IDEAL HARDWARE REQUIREMENTS = 64K, VIDEO TERMINAL-KEYBOARD
                  2 OR MORE DISK DRIVES, LINE PRINTER
250 REM:                  1 OR MORE DISK DRIVES, LINE PRINTER
260 REM: MINIMUM HARDWARE REQUIREMENTS = 28K, VIDEO TERMINAL-KEYBOARD
                  OR TELETYPE, 1 DISK DRIVE
270 REM: FOR SYSTEMS WITHLESS THAN 32K - REMOVE ALL OF THE REMARKS
280 REM:
290 REM:*****************************************************************
300 REM:******        THIS IS A SHELL-METZNER TYPE SORT              *****
310 REM:*********************************************************************
320 CLEAR 1000
330 Z=1
340 LPRINT
350 PRINT "NUMERIC - UTILITY SORT - RANDOM FILES ONLY"
360 LPRINT "NUMERIC - UTILITY SORT - RANDOM FILES ONLY"
370 INPUT "ENTER MAX # OF RECORDS TO SORT";NR
380 INPUT "ENTER FILE NAME";NA$
390 INPUT "ENTER INPUT DR#";AA
400 INPUT "ENTER OUTPUT DR#";AB
410 INPUT "ENTER INPUT FILE-START";AC
420 PRINT "OUTPUT FILE START WILL BE 0001"
430 PRINT "OUTPUT FILE NAME WILL BE ";NA$
440 INPUT "ENTER BLOCKING FACTOR -1- FOR NONE";AE
450 INPUT "ENTER RECORD LENGHT";AG
460 INPUT "ENTER SORT FIELD START & END DEMINISIONS AS XXX-XXX";AH$
470 LPRINT "SORT - ";NA$
480 LPRINT "FROM DR ";AA;" TO DR ";AB
490 LPRINT NA$;" FILE STARTS AT ";AC
500 LPRINT "OUTPUT FILE STARTS AT 0001"
510 LPRINT "OUTPUT FILE NANE WILL BE - ";NA$
520 LPRINT "USING BLOCKING FACTOR OF ";AE
530 LPRINT NA$;" RECORD LENGTH IS ";AG
540 LPRINT "SORT ON COLUMNS ";MID$(AH$,1,3);" TO ";MID$(AH$,5,7)
550 LPRINT "* * * EOF * * * MUST BE IN LAST RECORD"
560 DIM DV$(AE)
570 DIM B$(AE)
580 DIM B#(NR)
590 DIM BB(NR)
600 INPUT "ENTER -C- TO CONTINUE";C$
610 IF C$<>"C" THEN 350
630 IF AA=AB THEN UNLOAD AA:MOUNT AA:GOTO 650
640 UNLOAD AA,AB:MOUNT AA,AB
650 OPEN "R",1,NA$,AA
660 OPEN "R",2,NA$,AB
670 REC=AC
680 S1$=MID$(AH$,1,3)
690 S2$=MID$(AH$,5,7)
700 S1=VAL(S1$)'     1ST POSITION OF SORT FIELD
710 S2=VAL(S2$)'     LAST POSITION OF SORT FIELD
720 S3=S2+1-S1'      SIZE OF SORT FIELD
730 K=1
740 REM:************************************************************
750 REM: GET THE INPUT FILE AND LOAD ALL SORT FIELDS AND TAGS
760 REM: INTO THE MATRIX INPREPARATION FOR THE SORT. INPUT FILE
770 REM: UNTIL -EOF- REACHED.
780 REM:************************************************************
790 GET #1,REC
800 FIELD #1,128 AS DREC$
810 FOR I=1 TO AE
820 J=(I-1)*AG+(1)
830 B$(I)=MID$(DREC$,J,AG)
840 IF MID$(B$(I),1,3)="EOF" THEN 1110
850 A$=MID$(B$(I),S1,S3)
860 N=N+1
870 ZAP#=VAL(A$)'          ZAP#=SORT FIELD DATA AREA
880 REM:************************************************************
890 REM: SET UP THE SORT FIELD AND THE TAG FIELD CONTAINING THE
900 REM: SECTOR ADDRESS AND THE BLOCKING FACTOR
910 REM:************************************************************
920 RAC=REC
930 RAC=RAC+1000
940 REC$=STR$(RAC)
950 I$=STR$(I)
960 TAG$=REC$+I$
970 TAG=VAL(TAG$)'     TAG=SECTOR ADDRESS AND BLOCKING FACTOR
980 B#(K)=ZAP#
990 BB(K)=TAG
1000 K=K+1
1010 NEXT I
1020 REC=REC+1
1030 REM:************************************************************
1040 REM: CHECK TO MAKE SURE THAT THE FILE RESIDES ON ONE DISK
1050 REM:**************************************************************
1060 IF REC=2037 THEN 1090
1070 GOTO 790
1080 GOTO 1000
1090 PRINT "DATA OVERLAPS DISK-ILLEGAL"
1100 GOTO 1100
1110 IF AE<10 THEN X=1 ELSE X=2'  X=POSITION SIZE OF BLOCKING FACTOR
1120 LPRINT "TOTAL RECORDS ";N;" FREE MEMORY = ";FRE(X)
1130 REM:************************************************************
1140 REM: ROUTINE FOR PERFORMING THE ACTUAL SORTING AND SWAPPING
1150 REM: OF THE SORT FIELD AND THE TAGS
1160 REM:************************************************************
1170 M=N'        START OF SORT ROUTINE
1180 M=INT(M/2)
1190 REM:
1200 EXH=0
1210 IF M=0 THEN 1400'    END OF SORT-GOTO OUTPUT ROUTINE
1220 K=N-M
1230 J=1
1240 I=J
1250 L=I+M
1260 IF B#(I)<=B#(L) THEN 1320
1270 SWAP B#(I),B#(L)
1280 SWAP BB(I),BB(L)
1290 EXH=EXH+1
1300 I=I-M
1310 IF I>=1 THEN 1250
1320 J=J+1
1330 IF J>K THEN PRINT "M = ";M;" SWAPS MADE = ";EXH:GOTO 1180
1340 GOTO 1240
1350 REM:************************************************************
1360 REM: ROUTINE FOR PROCESSING THE SORTED TAGS, RANDOMLY GETTING
1370 REM: THE UNSORTED FILE AND COPYING IT IN SORTED FORM TO THE
1380 REM: SPECIFIED OUTPUT AREA
1390 REM:************************************************************
1400 LPRINT "ENTERING OUTPUT ROUTINE"
1410 K=1
1420 A=1
1430 J=0
1440 J=J+1
1450 TAG=BB(K)
1460 REC$=STR$(TAG)
1470 I$=MID$(REC$,6,1)
1480 REC$=MID$(REC$,2,4)
1490 REC=VAL(REC$)
1500 REC=REC-1000
1510 XI=VAL(I$)
1520 GET #1,REC
1530 FIELD #1, 128 AS DREC$
1540 DK$=DREC$
1550 I=(XI-1)*AG+(1)
1560 DV$(J)=MID$(DK$,I,AG)
1570 K=K+1
1580 IF K>N THEN 1710
1590 IF J=AE THEN 1600 ELSE 1440
1600 FIELD #2,128 AS ODEC$
1610 FOR L=1 TO AE
1620 DL$=DL$+DV$(L)
1630 NEXT L
1640 LSET ODEC$=DL$
1650 DL$=BLK$
1660 PUT #2,A
1670 A=A+1
1680 IF EFSW=2 THEN 1810
1690 IF EFSW=1 THEN 1870
1700 GOTO 1430
1710 EFSW=1
1720 IF J=AE THEN 1600
1730 EFSW=2
1740 J=J+1
1750 DV$(J)="EOF"
1760 JS=J
1770 IF J=AE THEN 1600
1780 J=J+1
1790 DV$(J)=BLK$
1800 GOTO 1770
1810 A=A-1
1820 LPRINT "** EOF ** IN OUTPUT SECTOR ";A;" DR ";AB;" RECORD # ";JS
1830 UNLOAD 0,1
1840 LPRINT "EOJ"
1850 PRINT "EOJ"
1860 GOTO 1860
1870 J=1
1880 EFSW=2
1890 GOTO 1750
1900 END
```



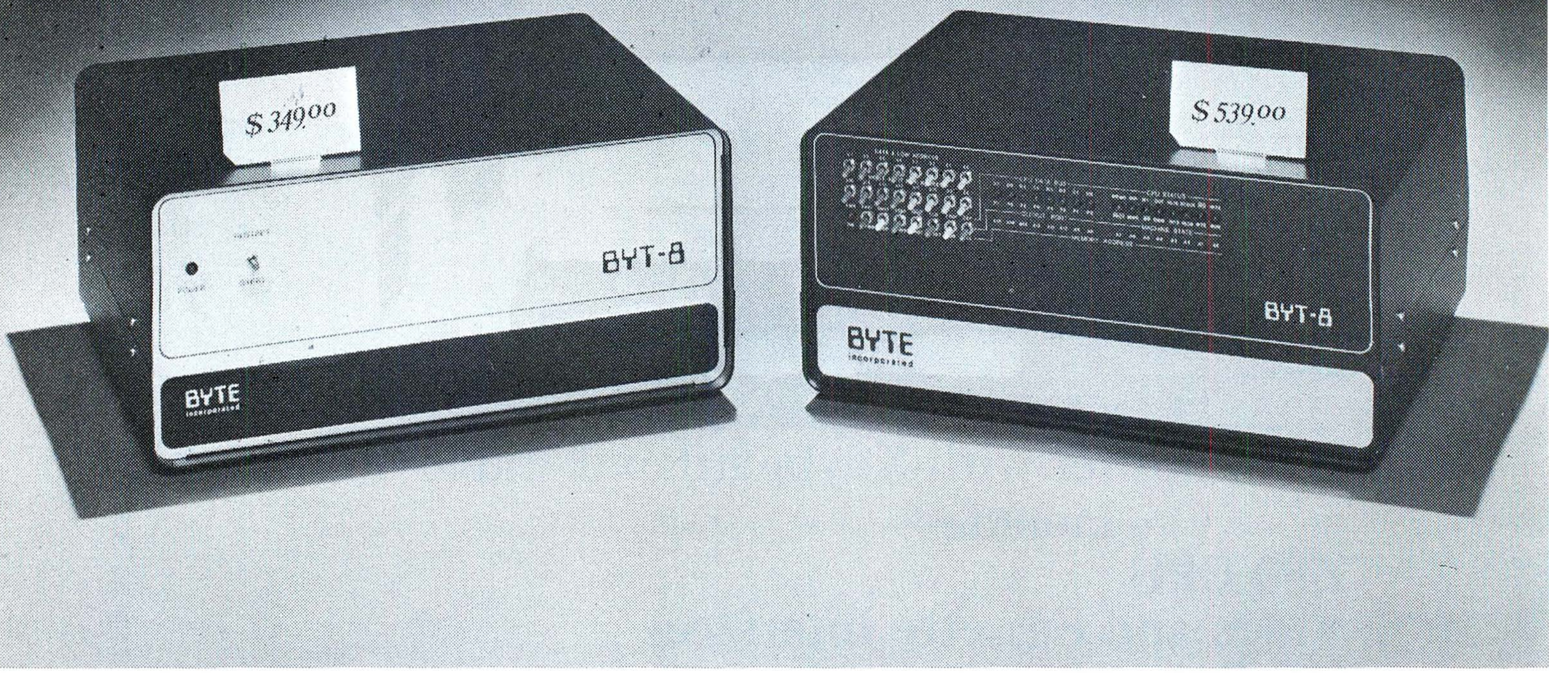
AUTHOR'S BACKGROUND

Bud Shamburger graduated from the University of Central Arkansas. He holds a B.S. Degree in Business Administration, Economics and Accounting. He attended IBM Customer Training Courses on Wiring Unit Record Data Processing Machines, Programming courses on 1401 RPG, 1401 SPC, 1401 Autocoder, 1440 Autocoder, 360 RPG and 360 BAL.

Mr. Shamburger has had 14 years with a large life insurance company. Also, he installed four IBM data processing systems comprising unit record, 1401, 1440, and 360s. He supervised, on a daily basis, the system design, programming and operations.

Bud now owns and manages the Ramada Inn in Conway, Arkansas.

The Byte Shop reaches a new low in microcomputers.



The Byt-8. It doesn't have a nifty (and expensive) front panel with lots of LED's and toggle switches.

And we obviously don't have a big full-color ad.

What we do have is the lowest priced microcomputer you can buy—built around the powerful and popular 8080A microprocessor.

For $349, you get the complete microcomputer card, motherboard, power supply and chassis in kit form.

The Byt-8 S100 bus is the same one used by Altair, IMSAI and most others so you have the greatest possible flexibility in choosing memory and input/output cards.

Optional cards from the Byte Shop include 4k, 8k or 16k of Random Access Memory, 4k or 8k of Programmable Read-Only Memory, a multiple input/output card, a TV typewriter card and, yes, a front panel bootstrap card, if you want the LED's and switches.

Even the CPU is optional. We'll sell you the chassis, motherboard and power supply for $229, and you can choose your own microcomputer card—a ZPU for instance?

Byt-8. It's the new low in price, but we're aiming for a new high in flexibility, delivery and support. See the Byt-8 at your nearest Byte Shop.

BYTE SHOP™
the affordable computer store

Stores now open in **Arizona,** Phoenix, Tempe, Tucson; **California,** Berkeley, Burbank, Campbell, Diablo Valley, Fresno, Hayward, Lawndale, Long Beach, Mountain View, Palo Alto, Pasadena, Placentia, Sacramento, San Diego, San Fernando Valley, San Francisco, Santa Barbara, Tarzana, Thousand Oaks, Westminster; **Colorado,** Arapahoe County, Boulder, Englewood; **Florida,** Cocoa Beach, Miami; **Indiana,** Indianapolis; **Minnesota,** Eagan, Minneapolis/St. Paul; **New York,** Levittown; **Oregon,** Beaverton, Portland; **Pennsylvania,** Bryn Mawr; **South Carolina,** Columbia; **Utah,** Salt Lake City; **Washington,** Bellvue; **Canada,** Vancouver; **Japan,** Tokyo. If there's no Byte Shop near you yet, please write or call Byte Inc., 1261 Birchwood Drive, Sunnyvale, California 94086 • (408) 734-9000 for more information on our Byt-8 system.

CIRCLE INQUIRY NO. 73

By Robert A. Stevens
Software Editor

Software Section

SUMMARY OF PROGRAMS FOR JUNE

This month's issue of INTERFACE AGE includes three software articles, featuring two business applications programs and one game program. June software programs include the following:

- PAYROLL developed by Bud Shamburger provides the small businessman with a complete and fully-documented business application software package. A copy of the BASIC listing is also included. PAYROLL is the first of a series of small business application programs developed by the author which will be published by INTERFACE AGE. Additional business program articles include a General Ledger software package, a Revolving Six Months Reservations software package, and a Front Desk Clerk-Night Auditor software package. This is the first time that any major business application program has been published in a magazine. INTERFACE AGE is honored to have the privilege of presenting this package, and we take this opportunity for the entire microcomputer industry to say thanks, Bud, for being so unselfish in sharing your software fruits with us. Keep up the good work.
- DAY OF THE WEEK program by Jim Huffman provides another practical business application program to determine the day of week for any date since September 14, 1752. As all the old time readers of INTERFACE AGE know, Jim Huffman is a regular contributor of small business application programs. Keep up the good work, Jim.
- STAR LANES developed by Steven Faber provides us with a new imaginative Monopoly-type microcomputer game that everyone can and will want to play if you have a microcomputer. Like the Monopoly game, STAR LANES combines financial and positional strategies as players attempt to lay claim to valuable pieces of space real estate between the stars in the Galaxy.

SOFTWARE BUGS

Gentlemen:

Found this bug in EXMON-6800, April 1977. INTERFACE AGE, Page 114.

```
*G
:G AA BB CC DDEE 0100 A042 XXXX

*G
:A AA
*G
:B BB
*G
:C CC
*G
:X CCDD (Instead of DDEE)
```

Otherwise real FB

Please advise on any patches.

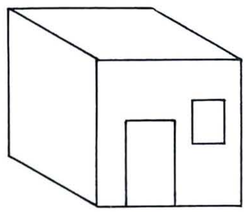
Stephen J. Stanley
Latham, N.Y.

MSD Program Listing

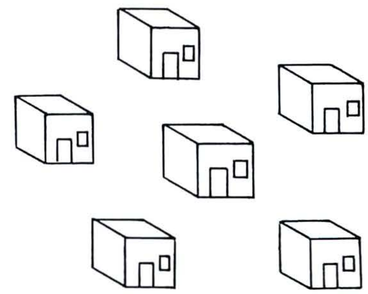
```
THE FOLLOWING LISTS SOFTWARE AVAILABLE FROM MSD ON A PREPAID BASIS
ONLY. THE TOTAL COST OF EACH PACKAGE IS THE SUM OF THE BASIC PRICE
+ CALIFORNIA SALES TAX, IF APPLICABLE, + POSTAGE AND HANDLING COST.
FOREIGN SUBSCRIBERS PLEASE NOTE THE DIFFERENT MAILING COST FOR
POSTAGE OUTSIDE USA. ADDRESS ALL INQUIRIES TO

      MICROCOMPUTER SOFTWARE DEPOSITORY
      2361 E. FOOTHILL BLVD.
      PASADENA, CALIF.,  91107
      OR CALL ( 213 ) 449-0616


MICROCOMPUTER SOFTWARE DEPOSITORY (MSD) PROGRAMS  DATE APRIL 1977 REV.0

PROGRAM MEDIA                                    NOTES
PTAC  PAPER TAPE ASSEMBLY CODE                   *  CALIF. SALES TAX REQUIRED
PTSC  PAPER TAPE SOURCE CODE                        FROM RESIDENCE OF CALIF.
PTOC  PAPER TAPE OBJECT CODE                     :  USA POSTAGE + HANDLING OR
PTBC  PAPER TAPE BASIC CODE                         THIRD CLASS USA POSTAGE +
PTAL  PAPER TAPE ASSEMBLY LISTING                   HANDLING OR SURFACE RATE
PTSL  PAPER TAPE SOURCE LISTING                     FOREIGN POSTAGE  @
PTOL  PAPER TAPE OBJECT LISTING                     THREE TIMES THIRD CLASS
PTOD  PAPER TAPE OBJECT DUMP                        USA POSTAGE RATE(STANDARD
PTBL  PAPER TAPE BASIC LISTING                      OR SURFACE RATE FOREIGN
CTAL  CASSETTE TAPE ASSEMBLY LISTING                POSTAGE @ FIVE TIMES USA
CTSL  CASSETTE TAPE SOURCE LISTING                  POSTAGE RATE (ALTERNATE)
CTOL  CASSETTE TAPE OBJECT LISTING               >  NEW PROGRAM LISTING
CTOD  CASSETTE TAPE OBJECT DUMP                  %  VENDOR SOFTWARE PACKAGE -
CTBC  CASSETTE TAPE BASIC CODE
CTBL  CASSETTE TAPE BASIC LISTING
HCAC  XEROX HARD COPY OF ASSEMBLY CODE
HCSC  XEROX HARD COPY OF SOURCE CODE
HCOC  XEROX HARD COPY OF OBJECT CODE
HCBC  XEROX HARD COPY OF BASIC CODE
HCAL  XEROX HARD COPY OF ASSEMBLY LISTING
HCALF FULL SIZE XEROX HARD COPY OF ASSEMBLY LISTING
HCSL  XEROX HARD COPY OF SOURCE LISTING
HCOL  XEROX HARD COPY OF OBJECT LISTING
HCOD  XEROX HARD COPY OF OBJECT DUMP
HCBL  XEROX HARD COPY OF BASIC LISTING
TEXT  XEROX HARD COPY OF PRINTED TEXT
PTTL  PAPER TAPE TEXT LISTING
CTTL  CASSETTE TAPE TEXT LISTING
MAN   MANUAL
HCGR  XEROX HARD COPY OF GRAMMAR
PTGR  PAPER TAPE COPY OF GRAMMAR
BBSL  XEROX HARD COPY OF BINARY BOOTSTRAP LOADER
HBSL  XEROX HARD COPY OF HEX BOOTSTRAP LOADER
PACK  PACKAGE PRICE INCLUDES ALL ITEMS/PROGRAM # WITH SYMBOL <

      SUFFIX C= HAND ASSEMBLED CODE
      SUFFIX L= COMPUTER FORMATED LISTING
      SUFFIX D= CODE DUMP IN OCTAL OR HEX
      SUFFIX F= FULL SIZE COPY

DEFINITIONS;

  ASSEMBLY LISTING: COMPUTER ASSEMBLED SOFTWARE PROGRAM LISTING
                    THAT INCLUDES SYMBOLIC ASSEMBLY LANGUAGE SOURCE
                    CODED INSTRUCTIONS WITH COMMENTS PLUS
                    EQUIVALENT MACHINE LANGUAGE OBJECT CODED
                    INSTRUCTINS AND MEMORY ADDRESS ASSIGNMENTS FOR
                    EACH INSTRUCTION ( SOURCE + OBJECT ).

  ASSEMBLY CODE:    SAME CONTENT AS ASSEMBLY LISTING BUT HAND ASSEMBLED.

  SOURCE LISTING:   SOFTWARE PROGRAM LISTING RESULTING FROM COMPUTER
                    SOFTWARE CONTROLLED ASSEMBLY PROCESS THAT INCLUDES
                    ASSEMBLY LANGUAGE SOURCE CODED INSTRUCTIONS WITH
                    COMMENTS. SOMETIMES, LINE STATEMENT NUMBERS ARE
                    INCLUDED FOR EACH INSTRUCTION.

  SOURCE CODE:      SAME CONTENT AS SOURCE LISTING BUT HAND ASSEMBLED.

  OBJECT LISTING:   SOFTWARE PROGRAM LISTING RESULTING FROM COMPUTER
                    SOFTWARE CONTROLLED ASSEMBLY PROCESS THAT ONLY
                    INCLUDES MACHINE READABLE OBJECT CODED INSTRUCTIONS
                    AND MEMORY ADDRESS ASSIGNMENTS.

  OBJECT CODE       SAME CONTENT AS OBJECT LISTING BUT HAND ASSEMBLED.

  HARD COPY:        XEROX OR PRINTED COPY.

  CODE:             HAND ASSEMBLED CODE ( SOURCE, OBJECT, OR ASSEMBLY
                    CODE ).

  LISTING:          COMPUTER FORMATED LISTING.

  DUMP:             COMPUTER MEMORY DUMP.


MSD PROGRAMS

CPU   SYMBOLIC DESCRIPTIVE                       MSD # &   P R
TYPE  NAME     NAME                              MEDIA     A E  +CALIF. TAX(*)
```

			C K V #	+USA POSTAGE(:)
6502	APPLECD	6502 APPLE COMPUTER DISASSEMBLER BY ALLEN BAUM & STEPHEN WOZNIAK-INTERFACE AGE, SEPT. 1976, VOL.1,#10.	1-TEXT < 1-HCAL < 1-PACK ↑	5.00+0.30+1.00 INC. WITH TEXT
8080	LPTIIHF	LOAD 8080 PAPER TAPE IN INTEL HEX FORMAT BY BURT HASHIZUME-INTERFACE AGE, OCT. 1976, VOL.1,#11.	2-PTAL < 0 2-TEXT < 2-HCAL < 2-PACK ↑	8.00+0.48+2.00 3.00+0.18+1.00 INC. WITH TEXT
8080	BFWOA	8080 BINARY FILES WITH OPTIONAL AUTOSTART BY WILLIAM H. JORDAN-INTERFACE AGE, OCT. 1976, VOL.1,#11.	3-PTAL < 0 3-PTOD < 3-TEXT < 3-HCAL < 3-PACK ↑	8.00+0.48+1.00 INC. WITH PTAL 3.00+0.18+1.00 INC. WITH TEXT
6800	MINOPS	MIN OPERATING SYSTEM BY ED KEITH & DENNIS HESCOX-INTERFACE AGE, OCT. 1976, VOL.1,#11. PTAL+ INCLUDES OPERATING INSTRUCTIONS, PAPER TAPE FORMAT AND SAMPLE RUN	4-PTAL+< 0 4-PTOD < 4-TEXT < 4-HCAL < 4-PACK ↑	8.00+0.48+2.00 INC. WITH PTAL 2.00+0.12+1.00 INC. WITH TEXT
8080	DBBDP	DR. BEATTIE'S BASIC DIET PLANNING BY DR. BEATTIE-INTERFACE AGE, OCT. 1976, VOL.1,#11.	5-TEXT < 0 5-HCBL < 5-PTBL < 5-PACK ↑	3.00+0.18+1.00 INC. WITH TEXT 8.00+0.48+2.00
6800	EZMERPS	ECHO 1, ZERO MEMORY, ECHO REVERSE & PRINT SUBROUTINES BY HOWARD BERENBON-INTERFACE AGE, OCT. 1976, VOL.1,#11.	6-PTAL < 0 6-TEXT < 6-HCAL < 6-PACK ↑	5.00+0.30+1.00 1.00+0.06+1.00 INC. WITH TEXT
8080	ESP-1	ESP-1 SOFTWARE PACKAGE BY MICHAEL SHRAYER-INTERFACE AGE, OCT. 1976, VOL.1,#11. PTGR IS PAPER TAPE COPY OF GRAMMAR.	7-PTOD <%0 7-MAN < 7-CTOD < 7-MAN < 7-PTGR < 7-HCGR < 7-PACK ↑	30.00+1.80+1.50 INC. WITH PTOD 30.00+1.80+1.50 INC. WITH CTOD 5.00+0.30+1.50 INC. WITH PTGR
8080	PTSP-1	PROCESSOR TECHNOLOGY SOFTWARE PACKAGE NO. 1 SUMMARY BY R. A. STEVENS-INTERFACE AGE, OCT. 1976, VOL.1,#11.	8-PTGR <%0 8-TEXT < 8-PACK ↑	5.00+0.30+1.50 INC. WITH PTTL
8080	ERAMMT	EXHAUSTIVE 8080 RAM MEMORY TEST PROGRAM BY T.F.TRAVIS -INTERFACE AGE, NOV. 1976, VOL.1,#12.	9-PTAL < 0 9-PTOD < 9-TEXT < 9-HCAL < 9-HCOD < 9-PACK ↑	6.00+0.36+2.00 INC. WITH PTAL 2.00+0.12+1.00 INC. WITH TEXT INC. WITH TEXT
6800	MEMDMP-1	SWTPC 6800 MEMORY DUMP PROGRAM MEMDMP-1 BY GARY KAY-INTERFACE AGE, NOV. 1976, VOL.1,#12.	10-PTAL < 0 10-PTSL < 0 10-PTOD < 10-TEXT < 10-HCAL < 10-PACK ↑	5.00+0.30+1.00 8.00+0.48+1.00 INC. WITH PTSL 1.00+0.06+1.00 INC. WITH TEXT
6800	ROBIT-1	SWTPC 6800 ROTATING BIT RAM MEMORY DIAGNOSTIC PROGRAM ROBIT-1 BY GARY KAY-INTERFACE AGE, NOV. 1976, VOL.1,#12.	11-PTAL < 0 11-PTSL < 0 11-PTOD < 11-TEXT < 11-HCAL < 11-PACK ↑	5.00+0.30+1.00 8.00+0.48+1.00 INC. WITH PTSL 1.00+0.06+1.00 INC. WITH TEXT
6800	MEMCON-1	SWTPC 6800 SHORT MEMORY ADDRESS CONVERGENCE PROGRAM MEMCON-1 BY GARY KAY-INTERFACE AGE, NOV. 1976, VOL.1,#12.	12-PTAL < 0 12-PTSL < 0 12-PTOD < 12-TEXT < 12-HCAL < 12-PACK ↑	5.00+0.30+1.00 8.00+0.48+1.00 INC. WITH PTSL 1.00+0.06+1.00 INC. WITH TEXT
6800	BJIB	BLACKJACK IN BASIC PROGRAM BY ED KEITH & DENNIS HESCOX. THE BJIB PAPER TAPE OBJECT CODE REQUIRES ROBERT UITERWYK'S SWTPC MICROBASIC OPERATING SYSTEM-INTERFACE AGE, NOV. 1976, VOL.1,#12. PTBL+ INCLUDES SAMPLE RUN, INSTRUCTIONS, LIST OF VARIABLES AND LIST OF ROUTINES.	13-PTBL 0 13-PTBL+< 13-TEXT < 13-HCBL < 13-PACK ↑	9.00+0.54+2.00 12.00+0.72+2.00 2.00+0.12+1.00 INC. WITH TEXT
6502	RFPR	REVISED FLOATING POINT ROUTINES FOR 6502* BY ROY RANKIN & STEVE WOZNIAK - INTERFACE AGE, NOV. 1976, VOL.1,#12. NOTE * - ORIGINAL MATH PACKAGE FIRST APPEARED IN DR. DOBB'S JOURNAL, AUG. 1976, VOL.1,#7.	14-PTOD < 1 14-PTAL < 14-PTSL < 14-TEXT < 14-HCAL < 14-PACK ↑	5.00+0.30+1.00 9.00+0.54+2.00 10.00+0.60+2.00 2.00+0.12+1.00 INC. WITH TEXT
6800	HISPDMUP	HIGH SPEED DOUBLE PRECISON MULTIPLICATION SUBROUTINE-HISPDMUP BY PERMISSION AND COURTESY OF MOTOROLA'S M6800 USER GROUP LIBRARY-INTERFACE AGE, NOV. 1976, VOL.1,#12.	15-PTAL < 0 15-TEXT < 15-HCAL < 15-PACK ↑	8.00+0.48+1.00 1.00+0.06+1.00 INC. WITH TEXT
6800	DIV16	REENTRANT 16 BIT DIVIDE SUBROUTINE - DIV16 BY PERMISSION AND COURTESY OF MOTOROLA'S M6800 USER GROUP LIBRARY- INTERFACE AGE, NOV. 1976, VOL.1,#12.	16-PTAL < 1 16-TEXT < 16-HCAL < 16-PACK ↑	8.00+0.48+1.00 1.00+0.06+1.00 INC. WITH TEXT
6800	RENTMUP	REENTRANT DOUBLE PRECISION MULTIPLICATION SUBROUTINE-RENTMUP BY PERMISSION AND COURTESY OF MOTOROLA'S M6800 USER GROUP LIBRARY-INTERFACE AGE, NOV. 1976, VOL.1,#12.	17-PTAL < 0 17-TEXT < 17-HCAL < 17-PACK ↑	8.00+0.48+1.00 1.00+0.06+1.00 INC. WITH TEXT
8080	HOMEC	COMPUTER OR CONTROLLER BY TERRY BENSON, INTEL - INTERFACE AGE, SEPT. 1976, VOL.1,#10.	18-PTAL < 0 18-PTSL < 18-TEXT < 18-HCAL < 18-PACK ↑	5.00+0.30+1.00 5.00+0.30+1.00 1.00+0.06+1.00 INC. WITH TEXT
8080	LCST	STARTREK BY LYNN COCHRAN-INTERFACE, JUNE 1976, VOL.1,#7.	19-PTBL < 0 19-TEXT < 19-HCBL < 19-PACK ↑	7.00+0.42+1.00 3.00+0.18+1.00 INC. WITH TEXT
8080	WSPG	WORD SEARCH PUZZLE GENERATOR BY RICHARD S. EDELMAN - INTERFACE, JULY 1976, VOL.1,#8.	20-PTBL < 0 20-TEXT < 20-HCBL < 20-PACK ↑	6.00+0.36+1.00 2.00+0.12+1.00 INC. WITH TEXT
8080	PGBIORHY	BIORHYTHM BY PAUL GREEN - INTERFACE AGE, AUG. 1976, VOL.1,#9.	21-PTBL < 0 21-TEXT < 21-HCBL < 21-PACK ↑	6.00+0.36+1.00 1.00+0.12+1.00 INC. WITH PTBL
8080	WDBIORHY	BIORHYTHMS IN PRACTICE BY WILLIAM L. DONHAN, M.D. - INTERFACE AGE, AUG. 1976, VOL.1,#9.	22-PTBL < 0 22-TEXT < 22-HCBL < 22-PACK ↑	8.00+0.48+2.00 2.00+0.12+1.00 INC. WITH TEXT
8080	REBJ	BLACKJACK BY RICHARD S. EDELMAN - INTERFACE AGE, AUG. 1976, VOL.1,#9.	23-PTBL < 0 23-TEXT < 23-HCBL < 23-PACK ↑	6.00+0.36+1.00 1.00+0.06+1.00 INC. WITH TEXT
8080	BLUFF	BLUFF BY PHIL FELDMAN & TOM RUGE - INTERFACE AGE, SEPT. 1976, VOL.1,#10.	24-PTBL < 0 24-TEXT < 24-HCBL < 24-PACK ↑	6.00+0.36+1.00 1.00+0.06+1.00 INC. WITH TEXT
6800	RABSIMB	RELATIVE ADDRESS BACK-STEPPER IN MICRO-BASIC BY J. HUFFMAN - INTERFACE AGE, DEC. 1976, VOL.1,#13.	25-PTBL < 0 25-HCBL < 25-TEXT < 25-PACK ↑	5.00+0.30+1.00 1.00+0.06+1.00 INC. WITH HCBL
6800	TEFT6800	TEXT EDITOR FOR THE SWTPC-6800 BY MARK BORGERSON - INTERFACE AGE, DEC. 1976, VOL.1,#13. HCAL IS COPY OF FULL SIZE ASSEMBLY LISTING.	26-PTAL < 0 26-PTOD < 26-HCAL < 26-TEXT < 26-PACK ↑	15.00+0.90+2.00 10.00+0.60+2.00 3.00+0.18+1.50 2.00+0.12+1.25
8080	WPATBX	WANG'S PALO ALTO TINY BASIC BY ROGER RAUSKOLB - INTERFACE AGE, DEC. 1976, VOL.1,#13. HCAL & HCSL ARE COPIES OF FULL SIZE CODE	27-PTSL < 0 27-PTOD < 27-HCAL < 27-TEXT < 27-HCSL < 27-PACK ↑	20.00+1.20+3.00 10.00+0.60+2.00 4.00+0.24+1.50 INC. WITH HCAL 4.00+0.24+1.50
8080	LLLBI	LLL 8080 BASIC INTERPRETER GRAMMAR BY JERRY BARBER & ROYCE ECKARD - SUBMITTED BY E.R. FISHER - INTERFACE AGE, DEC. 1976, VOL.2,#1(PART 1). JAN. 1977, VOL.2,#2(PART 2). FEB. 1977, VOL.2,#3(PART 3). MARCH 1977, VOL.2,#4(PART 4). TEXT1 IS PART 1, TEXT2 IS PART 2, ETC. HCAL2,3, & 4 ARE FULL SIZE XEROX COPIES OF ASSEMBLY PROGRAM LISTINGS OF PARTS 2,3, & 4.	28-TEXT1< 0 28-HCAL2< 28-TEXT2< 28-HCAL3< 28-TEXT3< 28-TEXT4< 28-HCAL4<	5.00+0.30+2.00 5.00+0.30+2.00 3.00+0.18+2.00 5.00+0.30+2.00 3.00+0.18+2.00 3.00+0.18+2.00 3.00+0.18+2.00
SC/MP	NIBL	NIBL-NATIONAL'S TINY BASIC GRAMMAR FOR SC/MP BY PHIL ROYBAL - INTERFACE AGE, DEC. 1976, VOL.2, #1. ASSEMBLY LISTING PUBLISHED JAN. 1977, VOL.2,#1.	29-TEXT < 0 29-HCAL < 29-PTSL < 29-PTOD < 29-PTGR < 29-PACK ↑	5.00+0.30+2.00 10.00+3.00+2.00 10.00+3.00+2.00 5.00+1.50+1.00 2.00+0.12+1.00
SC/MP	MWBAGFLS	BAGFLS BY DR. MARVIN WINZINKEAD BY PERMISSION & COURTESY OF NATIONAL SEMICONDUCTOR - INTERFACE AGE, DEC. 1976, VOL.2,#1.	30-PTBL < 0	5.00+0.30+2.00
8080	AMS80	AMSAT 8080 STANDARD DEBUG MONITOR BY RICHARD C ALLEN & JOE KASSER - BYTE # 13, SEPT. 1976, VOL.2,#1. SUBMITTED BY JOE KASSER.	31-PTSL < 2 31-PTOD < 31-PACK ↑	15.00+0.90+2.00 5.00+0.30+2.00
6800	BAFCMP	BASIC ALGORITHMS FOR COMMON MATH FUNCTIONS BY MICHAEL P. BURTON - INTERFACE AGE, JAN. 1977, VOL.2,#2.	32-PTBL < 1 32-TEXT < 32-PACK ↑	6.00+0.36+1.00 2.00+0.12+1.00
8080	ECMSO	MICROCOMPUTER STOCK OPTIONS BY EDWARD CHRISTIANSON - INTERFACE AGE, FEB. 1977, VOL.2,#3.	33-PTBL < 0 33-HCBLF 33-HCBLF< 33-TEXT < 33-PACK ↑	15.00+0.90+2.00 5.00+0.30+2.00 INC. WITH PTBL 5.00+0.30+2.00
8080	BMRNG	RANDOM NUMBER GENERATOR BY BOB MARTIN - INTERFACE AGE, FEB. 1977, VOL.2,#3.	34-PTAL < 0 34-PTSL < 34-TEXT < 34-HCALF 34-HCALF< 34-PACK ↑	7.00+0.42+2.00 6.00+0.36+2.00 2.00+0.12+1.00 4.00+0.24+1.00 INC. WITH PTAL
8080	RNDFGCST	RND FUNCTION GENERATOR CHI-SQUARE TEST PROGRAM BY BOB MARTIN - INTERFACE AGE, FEB. 1977, VOL.2,#3.	35-PTBL < 35-HCBLF< 35-PACK ↑	4.00+0.24+1.00 INC. WITH PTBL
8080	TTMOCSR	8080 MEMORY OBJECT CODE SEARCH ROUTINE BY T. E. TRAVIS - INTERFACE AGE, FEB. 1977, VOL.2,#3.	36-PTAL < 0 36-PTSL < 36-TEXT < 36-HCALF< 36-HCALF 36-PACK ↑	5.00+0.30+1.00 5.00+0.30+1.00 1.00+0.06+1.00 INC. WITH TEXT 2.00+0.12+1.00
8080	TDOMP	8080 OCTAL MONITOR PROGRAM BY THOMAS E. DOYLE - INTERFACE AGE, FEB. 1977, VOL.2,#3.	37-PTAL < 0 37-PTSL < 37-TEXT < 37-HCALF 37-HCALF< 37-PTOD < 37-PACK ↑	8.00+0.48+2.00 8.00+0.48+2.00 2.00+0.12+1.00 4.00+0.24+1.00 INC. WITH PTAL 5.00+0.30+1.50
8080	LLLBFPMP	LLLBASIC FLOATING POINT MATH PACKAGE BY DAVID MEAD & MODIFIED BY HAL BRAND AND FRANK OLKEN - INTERFACE AGE, FEB. 1977, VOL.2,#3.	38-TEXT < 0 38-HCALF<	3.00+0.18+2.00 5.00+0.12+2.00

WE'VE GOT IT ALL TOGETHER



One Big Store
Us



Lotta Little Stores
THEM

People ask us when we're going to open more stores. That would be a logical result of our success. We've expanded, but all in one location, in Santa Monica. This means we have more people, more demonstration equipment, more inventory, and more spare parts. We've concentrated our resources. For the very best information and service, ask us, we're

THE MOST EXPERIENCED COMPUTER DEALERS ANYWHERE

THE COMPUTER STORE

820 Broadway
Santa Monica, Calif. 90401
Phone (213) 451-0713

Store hours: Tues-Fri: Noon – 8 pm
Saturday: 10 am – 6 pm

Located 2 blocks North of the Santa Monica Freeway at the Lincoln Blvd. exit

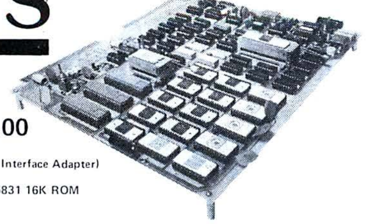
mits altair™
COMPUTER CENTER

Authorized dealer for MITS, Cromemco, North Star, Peripheral Vision, TDL, Microterm, SWTPC, Polymorphic, Multiterm, Oliver, and Sanyo. BankAmericard and Mastercharge welcome.

CIRCLE INQUIRY NO. 86

8080	Z80MERP	Z80 MITS 12K EXTENDED BASIC PATCHES BY MARTIN D. GRAY - INTERFACE AGE, MARCH 1977, VOL.2,#4.	39-TEXT < 0 39-HCALF< 39-PACK ↑	1.00+0.06+1.00 1.00+0.06+1.00
6502	RJBAST	6502 APPLE STAR-TREK BY ROBERT J. BISHOP -	40-TEXT < 0 40-HCBL < 40-PACK ↑	3.00+0.18+1.00 INC. WITH TEXT
6800	AMIPROTO	AMI'S PROTO DEVELOPMENT SOFTWARE FOR EVK SERIES PROTOTYPING BOARDS BY PERMISSION AND COURTESY OF AMERICAN MICROSYSTEMS EDITED BY R.A.STEVENS- INTERFACE AGE, FEB. 1977, VOL.2,#3.	41-TEXT < 0 41-HCALF< 41-PACK ↑	3.00+0.18+1.00 5.00+0.30+2.00
8080	CONSOL	CONSOL 1K RESIDENT OPERATING SYSTEM BY PERMISSION AND COURTESY OF PROCESSOR TECHNOLOGY- INTERFACE AGE, JAN. 1977, VOL.2,#2.	42-TEXT < 0 42-HCALF< 42-PACK ↑	3.00+0.18+1.00 5.00+0.30+2.00
8080	ODT-80	LLL BASIC OCTAL DEBUGGING PROGRAM BY E. R. FISHER- INTERFACE AGE, MARCH 1977, VOL.2,#4.	43-TEXT < 0 43-HCALF< 43-PACK ↑	3.00+0.18+2.00 5.00+0.30+2.00
6800	(RS)*3	RESIDENT 6800 REENTRANT SELF-RELATIVE SUBROUTINE PACKAGE FOR EVK 6800 MICROCOMPUTER BOARDS BY PERMISSION AND COURTESY OF AMERICAN MICROSYSTEMS EDITED BY R.A. STEVENS- INTERFACE AGE, MARCH 1977, VOL.2,#4.	44-TEXT < 0 44-HCALF< 44-PACK ↑	3.00+0.18+1.00 5.00+0.30+2.00
6800	EXMON	6800 MIKBUG EXTENDED MONITOR SYSTEM BY MICHAEL BURTON- INTERFACE AGE, APRIL 1977, VOL.2,#5.	45-TEXT < 0 45-HCALF< 45-PTAL < 45-PTOD < 45-PACK ↑	2.00+0.12+1.00 3.00+0.18+1.50 9.00+0.54+2.00 5.00+0.30+2.00
8080	LMCOS	8080 CASSETTE OPERATING SYSTEM (COS) BY LORIN MOHLER- INTERFACE AGE, APRIL 1977, VOL.2,#5.	46-TEXT < 46-PTSL < 46-HCALF< 46-PACK ↑	3.00+0.18+1.00 10.00+0.60+2.00 5.00+0.30+1.00
6800	MHFTIHFC	MOTOROLA 6800 HEX FORMAT TO INTEL FORMAT SOFTWARE CONVERTER BY FLOYD NORDIN-	47-TEXT < 0 47-PTAL < 47-PTSL < 47-PTOD < 47-HCALF< 47-HCODF< 47-PACK ↑	1.00+0.06+1.00 5.00+0.30+2.00 5.00+0.30+2.00 3.00+0.18+1.00 3.00+0.18+1.00 INC. WITH HCAL
8080	MMGTEW	GRAPHICS- THE EASY WAY BY MARVIN MALLON- INTERFACE AGE, MARCH 1977, VOL.2,#4.	48-TEXT 0 48-HCBLF	3.00+0.18+1.00 5.00+0.30+1.00
8080	CBMS	BYTEMOVER SOFTWARE FOR THE CROMEMCO 8K BYTESAVER BOARD - PERMISSION AND COURTESY OF CROMEMCO EDITED BY ROGER EDELSON- INTERFACE AGE, JAN. 1977, VOL.2,#2.	49-TEXT 0 49-HCAL	5.00+0.30+1.00 INC. WITH TEXT
8080	FNOCDA	8080 OBJECT CODE DIS-ASSEMBLER BY FLOYD L. NORDIN- STANDARD VERSION HANDLES UP TO 1K LABLES & ASSIGNS SYMBOLIC NAMES. ASCII CHARACTER LIST PIN POINTS EMBEDDED TABLES. INCLUDES BOTH ASSEMBLY AND SOURCE OUTPUT MODES VIA YOUR OUTPUT DRIVERS. PROGRAM RESIDES AT TOP OF MEMORY. STANDARD VERSIONS AVAILABLE FOR 16K, 24K, 32K, 48K AND 64K BYTES OF MEMORY. OTHER VERSIONS WITH ADDITIONAL LABLE SPACE AND/OR DIFFERENT MEMORY SIZE ARE AVAILABLE.	50-PTOD <%0 50-MAN < 50-PACK ↑	40.00+2.40+2.00 5.00+0.30+1.00 45.00+2.70+3.00
6800	SWTPMB	SWTP'S 6800 MICROBASIC VER. 1.4 BY ROBERT H. UITERWYK AND BY PERMISSION & COURTESY OF SOUTHWEST TECHNICAL PRODUCTS CORP. SWTPC 6800 COMPUTER NEWSLETTER #1, JUNE 1976.	51-PTOD 0	15.00+0.90+2.00
6800	EVKMB	SWTP'S 6800 MICROBASIC VER. 1.4 MODIFIED FOR AMI'S 6800 EVK MICROCOMPUTER BOARDS BY STEVEN D. WALL.	52-PTOD 0	15.00+0.90+2.00
8080	CCOKEN	ARTIFICAL INTELLIGENCE TIC-TAC-TOE PROGRAM (OR MENACE OF THE MICROWORLD) BY KEN BERKUM -INTERFACE AGE, MARCH 1977, VOL.2,#4.	53-PTBL < 0 53-TEXT < 53-HCBL < 53-HCBL 53-PACK ↑	10.00+0.60+2.00 2.00+0.12+1.00 INC. WITH PTBL 2.00+0.12+1.00
6800	JHDOTWP	DAY OF THE WEEK PROGRAM BY JIM HUFFMAN-'	54-PTBL < 0 54-TEXT < 54-HCBL < 54-HCBL 54-PACK ↑	6.00+0.36+1.00 1.00+0.06+1.00 INC. WITH PTBL 1.00+0.06+1.00
6800	JHCBBP	CHECKBOOK BALANCER PROGRAM BY JIM HUFFMAN -	55-PTBL < 0 55-TEXT < 55-HCBL < 55-HCBL 55-PACK ↑	6.00+0.36+1.00 1.00+0.06+1.00 INC. WITH PTBL 1.00+0.06+1.00
8080	HEXDUMP	INTEL HEX FORMAT PAPER TAPE DUMP PROGRAM BY ALAN R. MILLER -	56-PTAL < 1 56-PTSL < 56-PTOD < 56-HCAL < 56-HCAL 56-HCSL < 56-HCSL 56-PACK ↑	8.00+0.48+2.00 8.00+0.48+2.00 5.00+0.30+1.00 INC. WITH PTAL 2.00+0.12+1.00 INC. WITH PTSL 2.00+0.12+1.00
8080	CONVERT1	NUMBER BASE CONVERSION- NON DISC VERSION BY JOHN W. SWAIN-	57-PTBL < 0 57-TEXT < 57-HCBL < 57-HCBL 57-PACK ↑	7.00+0.42+1.00 2.00+0.12+1.00 INC. WITH PTBL 1.00+0.06+1.00
8080	CONVERT2	NUMBER BASE CONVERSION- DISC BASED VERSION OF CONVERT1 ABOVE BY JOHN W. SWAIN	58-PTBL < 0 58-TEXT < 58-HCBL < 58-HCBL 58-PACK ↑	7.00+0.42+1.00 2.00+0.42+1.00 INC. WITH PTBL 1.00+0.06+1.00
Z80	SERIAL	USER TTY HANDLER FOR THE Z80 DELEVOPMENT SYSTEM BY RICHARD E. MALY -	59-TEXT 0 59-HCAL	3.00+0.18+1.00 2.00+0.12+1.00
6800	MEMTEST	A BETTER 6800 MEMORY TEST BY ED KEITH-	60-PTAL < 0 60-PTSL < 60-PTOD < 60-TEXT < 60-HCAL < 60-HCAL 60-HCSL < 60-HCSL 60-PACK ↑	8.00+0.48+2.00 8.00+0.48+2.00 3.00+0.18+1.00 2.00+0.12+1.00 INC. WITH PTAL 2.00+0.12+1.00 INC. WITH PTSL 2.00+0.12+1.00
8080	AMLIFE	JOHN CONWAY'S GAME OF LIFE PROGRAMMED BY ALAN R. MILLER	61-PTAL < 4 61-PTSL < 61-PTOD < 61-TEXT < 61-HCAL < 61-HCAL 61-HCSL < 61-HCSL 61-PACK ↑	15.00+0.90+2.00 10.00+0.60+2.00 5.00+0.30+1.00 2.00+0.12+1.00 INC. WITH PTAL 2.00+0.12+1.00 INC. WITH PTSL 2.00+0.12+1.00
8080	SFSL	STAR LANES PROGRAM BY STEVEN FABER -	62-PTBL < 0 62-HCBL < 62-TEXT < 62-HCBL < 62-HCBL 62-PACK ↑	15.00+0.60+2.00 2.00+0.12+1.00 2.00+0.12+1.00 INC. WITH PTBL 2.00+0.12+1.00
8080	PAYROLL	PAYROLL PROGRAM IN BASIC BY BUD SHAMBURGER - INTERFACE AGE, JUNE 1977, VOL.2,#7.	64-PTBL < 0 64-HCBL < 64-TEXT < 64-PACK ↑	20.00+1.20+2.00 5.00+0.30+2.00 2.00+0.12+1.00
8080	TCOS	TAPE CASSETTE SOFTWARE OPERATING SYSTEM FOR THE 8080 MICROCOMPUTER BY DANIEL T. DRUID - INCLUDES 8080 ASSEMBLER + LINE TEXT EDITOR + MONITOR - TAPE FORMAT IS DON TARBELL7S OR PROCESSOR TECHNOLOGY'S CUTS STANDARD.	65-CTOD < 0 65-MAN <	30.00+1.80+2.00 5.00+0.30+1.00

ADVANCED ★ MICROCOMPUTER PRODUCTS



EVK 99

(1) EVK 99 consists of the following only — **$133.00**

Qty.	
(1)	PCB 10½ x 12
(1)	6800 8 bit CPU
(1)	6850 ACIA (Asynchronous Communications Interface Adapter)
(1)	6820 PIA (Peripheral Interface Adapter)
(2)	6830 ROM Subroutine Program Library (1) 6831 16K ROM
(4)	6810-1 RAM
(1)	Operating Manual & Instructions

To Implement fully expanded system additional IC's are required. (See Photo)

(2)	EVK 99-EX Kit Fully expanded	$449.95
(3)	Universal Kluge Board	95.00
(4)	16K Byte RAM Board	75.00
(5)	6 Slot Mother Board	35.00
(6)	Extender Board	45.00
(7)	Video Board/Disk	95.00
	Connectors $6.50 each	
	PCB Ejectors 6 for $3.00	

Plus now available AMI MAD 16K ROM Macro Assem Chip on ROM $30.00
Coming soon AMI 8K Basic

★ TV GAMES ★

AY38500-1/TMS 1955 ONLY $16.95
AY38500 (Europe Version) ONLY $24.95

TV KIT NO. 1
Includes AY 38500-1 TV Game Chip PC Board for video composite output plus instructions. Add $5.95 for 2MHz crystal. $29.95

TV KIT NO. 2
Includes AY38500-1 TV Game Chip, PC Board, Switches, pots, speaker, crystal, XFMR, Bridge and all parts required for video composite. Works super with terminal. Includes instructions and data sheets. $39.95

MM57100 NSC TV Game Chip	$16.95
MM53104 Clock Driver	3.75
LM1889 Modulator	3.00
RF Modulator Model 1021 Assembled	$8.95

★ RAM'S ★

21L02(450ns)	1.75
21L02(250ns)	2.25
2102(450ns)	1.69
2102(650ns)	1.59
2102(1 sec)	1.40
2111	3.95
21L11	4.25
2112	2.95
2101	2.95
21L01	3.95
74C89	4.95
74S189	2.95
7489	1.88
4104*	12.95
4804*	12.95
4200*	12.95
4402*	12.95
9130/9131*	14.95
9140/9141*	14.95
TMS4050	4.25
TMS4060	4.25
4096	4.95
2107B-4	4.25
MM5261	3.95
MM5262	1.95
MM5280	4.95
8599	1.88
P3101	2.95
5101C-E	9.95
3107	3.95
1101	1.95
1103	1.95
4008-L	2.95

*Supply Limited

★ SOCKETS ★

14 Pin ww 1 level	$ .30
14 Pin ww 2 level	.33
14 Pin ww 3 level	.37
16 Pin ww 1 level	.31
16 Pin ww 2 level	.34
16 Pin ww 3 level	.38
18 Pin ww 3 level	.60
22 Pin ww 3 level	.89
24 Pin ww 1 level	.70
24 Pin ww 2 level	.75
24 Pin ww 3 level	.85
40 Pin ww 1.25	1.25
8 Pin S/T	.17
14 Pin S/T	.20
16 Pin S/T	.22
18 Pin S/T	.31
22 Pin S/T	.35
24 Pin S/T	.41
28 Pin S/T	.49
40 Pin S/T	.63

★ PLESSEY ★

SL1610C	$ 1.95
SL1611C	1.95
SL1612C	1.95
SL1613	1.95
SL1621C	2.95
SL1623C	2.95
SL1626C	2.95
SL1630C	1.95
SL1640C	1.95
SL1641 C	5.95
SL1652C	7.50
SL1680C	5.95
SL560	9.95

★ SPECIALITY CHIPS ★

34702 Baud Rate Gen	$15.95
upD372 Floppy Controller	55.00
upD371 Mag Tape Controller	49.95
App Notes for 372 Floppy	6.95
WD1771 Floppy Controller	69.95
AY5 3550 4¾ DVM Chip	24.95
8038CC Wave Gen	3.50
MK5007 Counter	6.95
AY5 3507 DVM Chip	12.95
WD1941 Dual Baud Gen	9.95

★ NEW CTS DIPSWITCHES ★

CTS206-4	$1.75
CTS206-5	$1.75
CTS206-6	$1.75
CTS207-7	$1.75
CTS208-8	$1.95
CTS209-9	$1.95
CTS209-10	$1.95

★ EXAR ★

XR2556CP	$2.95
XR2240CP	4.20
XR320P	1.40
XR2208CP	4.75
XR2211CP	5.95
XR2567CP	1.80
XR1310CP	3.00
XR1800CP	3.00
XR2206CP	5.25
XR2207CP	3.75
XR742CP	3.95
XR4202CP	4.25
XR2265	6.95

★ PROM'S ★

6330-1/82S23	$ 2.95
6331-1/82S123	2.95
6300-1/82S126	3.50
6301-1/82S129	3.50
6340-1/3604	18.95
6341-1/3624	18.95
6305-1	9.95
6306-1	9.95
6352	18.95
6353	18.95
2708	34.95
1702A	7.95
1702A-6	4.49
5204	16.95
6834	21.95
6834-1	16.95

★ DIVIDERS ★

SP8600	$ 6.95	SP8632	10.00
SP8601	4.25	SP8634	35.00
SP8602	16.00	SP8635	27.50
SP8603	14.50	SP8638	22.50
SP8604	8.25	SP8637	18.00
SP8607	17.00	SP8640	6.20
SP8613	17.50	SP8641	7.50
SP8614	18.00	SP8642	12.50
SP8615	20.00	SP8643	20.00
SP8616	22.00	SP8646	6.50
SP8620	12.50	SP8647	8.00
SP8621	8.50	SP8650	25.00
SP8622	6.50	SP8651	18.50
SP8630	20.00	SP8652	12.00
SP8631	12.00	SP4020	$12.95
CB Sythesizer		SP8790	16.95
8921	$12.95	SP8794	9.95
8922	Pair	SP8685	16.95

★ CRYSTALS ★

Frequency	Application	Price
1.0MH$_3$	6800/S6860	$ 5.85
2.0MH$_3$	F-8/TV Games	5.85
2.097152MH$_3$	MM5378/79 Auto	5.85
2.4576MH$_3$	34702 Bit Rate Gen	5.85
3.579545MH$_3$	MM5369 (TV Color)	3.95
4.0MH$_3$	4004/4040	4.95
4.194304MH$_3$	8038	5.95
4.91520MH$_3$	Std. CLK Freq.	5.95
5.0MH$_3$	Several MPU's	4.95
5.7143MH$_3$	PACE	5.95
6.0MH$_3$	Misc	4.95
10.0MH$_3$	Several MPU's	4.95
13.0MH$_3$	Misc	4.95
14.31818	Misc	4.95
18.0MH$_3$	8080/8008/8224	4.95
18.432MH$_3$	8080/8008/8224	5.95
20.0MH$_3$	Several MPU's	4.95
22.1184MH$_3$	8080A	5.95
27.000MH$_3$	8080A	5.95
36.000MH$_3$	8080A	5.95
48.000MH$_3$	TIM9904	5.95
100KC	Misc	12.95

★ MICROPROCESSOR PRODUCTS ★

8080A/9080A	$19.50	6850	9.95
S6800	24.95	6852	11.95
2901	22.95	6860	15.95
CP1600	55.95	6871A	19.95
Z80	44.95	6800 Programming Manual	15.00
6502	24.95	6800 Hardware Manual	15.00
8008-1	17.95	6800 Tiny Basic Paper Tape	20.00
8212	4.25	6800 Tiny Basic Eprom	125.00
8214	8.95	6831 Mad Rom (Macro Assem)	30.00
8216	4.25	2902	3.95
8224	4.95	2905	9.95
8226	4.95	2906	11.95
8228	8.75	2907	10.75
8251	14.95	2909	21.95
9551	14.95	2911	3.95
9555	14.95	2918	6.75
6810-1	4.95	29720	7.95
6810	5.95	29721	7.95
6820	8.95	3881/Z80 PIC	9.95
6834-1	16.95	3882/Z80CTC	9.95
6834	21.95		

★ SPECIAL ★

While supply lasts

AM1702A-6 EPROM
$4.49 each 10/$39.95
Direct From AMD

★ S-100 COMPATIBLE PRODUCTS ★

Logos I 8K Ram Board	$219.95 Intro Price
801C 8K Ram Board	$207.95
8 Slot Mother Board (Expandable)	$ 79.95 w/Connectors
Extender Board	$ 34.95
Universal Proto Board w/Instructions	$ 39.95
32K Static Ram Board Kit (Allow 30 Days)	$1150.00
S100 PSIO - Same as Proc. Tech 3P+S	$125.00

★ CHAR GEN/ENCODERS ★

R032513 Lower Case	10.95
R032513 Uppercase	9.95
AY52376 Keyboard Encoder	14.95
AY53600 Keyboard Encoder	14.95
MM6571 Char gen	19.95
MM6574 Char gen	19.95
MM6575 Char gen	19.95

★ CONNECTORS ★

S100 BUS W/W IMSAI	$5.00
S100 BUS S/T IMSAI	5.00
S100 BUS W/W ALTAIR	5.50
S100 BUS S/T ALTAIR	5.25
RS232 25 Pin Male DB25P	3.50
PS232 25 Pin Female DB25S	3.95
Plastic Hood	.75

★ SPECIALS ★

8T26	2 for $4.95
★ 8T97/8097	6 for $5.00
1488	$1.25
1489	$1.25
DM8130	2 for $4.95
DM8131	2 for $4.95
74LS367	$ .72
74LS368	$ .79
MH0026	$2.95
75452	10/2.50
74LS138	$1.39
74166	$ .69
741HC	10/2.50
93L00	10/3.50
LM301AH	10/2.50
LM308H	10/4.95
MC1733CL	10/4.95 ★
7438	10/2.50
★ 4558	10/4.95
LM306H	10/4.95
8T22A	10/2.95

★ MOTOROLA ★

MEK6800D2 – 6800 KIT ONLY $235.00
Also offering following for Exerciser & MEK D1 & D2 Kits

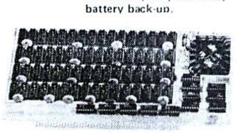
9601 16 Slot Mother Bd.	$175.00
9602 16 Slot Card Cage	72.00
9610 Proto Board	36.00
9615 4K EPROM Module (1702A)	350.00
9615K 4K EPROM Kit Module	275.00
9620 16 Port Parallel I/O	375.00
9626 8K Static RAM Module	350.00
9626K 8K Static RAM Kit	275.00
9650 8 Port Duplex Asyn Serial I/O	395.00

All assembled & tested not Kits

PLUS MOTOROLA TV MONITORS – PRIME
★ Model M3000-100 12" display $219.95
Model M2000-155 9" display $199.95 ★
Add $10.00 for shipping

★ LOGOS I ★

THE ULTIMATE 8K RAM BOARD
Features: Lowpower 21L02, 450ns, Dip Switch Selectable addressing down to 256 Byte blocks, No wait states, fully buffered, battery back-up.



Intro Price $219.95
Regular Price $248.00

★ MISCELLANEOUS ★

8/9 Conductor Ribbon Cable	.25/ft
Red Led's	5/1.00
Green Led's	3/1.00
Yellow Led's	3/1.00
19 Key Keyboard	$11.95
63 Key Keyboard	$19.95
3.5V Buzzer	$ .95
C & K V25 Toggle Switch	$ 1.50
Centralab PA2001 Rotary	$ 1.50
680.5220 (TO220 Dual Heatsink)	1.50
PEC 7A 125V 3 conductor cord	.99

FUNCTION GEN KIT

XR2206KA IC PCB, Inst.	$18.95
XR2206KB Complete Kit	$29.95

★ DATA BOOKS ★

NSC Digital	$ 3.95
NSC Linear	4.95
NSC Linear A/N Vol. I	2.95
NSC Linear A/N Vol. II	2.95
NSC CMOS	2.95
NSC Audio	2.95
NSC Voltage Reg	2.95
NSC Memory	3.95
NSC	3.95
NSC Special Functions	3.25
NSC Mos/LSI	4.25
NSC Transistors	2.95
Iasis Microprocessor Handbook	7.95
Iasis Complete up Learning Course	99.50
Intel MC580 Manual	4.95
Intel MCS40 Manual	4.95
Intel MCS8 Manual	2.95
Raytheon Linear	2.95
Raytheon Quads/Duals	1.95
TI Linear Control	4.95
Osborne Introto Micropuler Vol. I	7.50
Osborne Introto Microputers Vol. II	12.50
Osborne 8080 Programming for Logic Design	7.50

I C MARKET PLACE ★

★ LINEAR ★

LM300H	.80	LM324N	1.65
LM301H	.45	LM339N	1.55
LM301CN	.45	LM340K-5	1.75
LM302H	1.25	LM340K-8	1.75
LM304H	1.20	LM340K-12	1.75
LM305H	.85	LM340K-15	1.75
LM306H	.95	LM340K-18	1.75
LM307CN	.45	LM340K-24	1.75
LM307H	.45	LM370H	1.65
LM308H	1.00	LM373N	3.95
LM308CN	1.00	LM377N	4.50
LM309H	1.10	LM380N	1.00
LM309K	1.25	LM381N	1.90
LM310H	1.15	LM384N	2.49
LM311H	.90	LM555CN	.59
LM311CN	.59	LM556CN	1.69
LM312H	1.95	LM566CN	2.00
LM318H	1.50	LM567CN	1.95
LM318N	1.50	LM565CN	1.95
LM319N	1.95	LM565H	1.95
LM319H	1.95	LM703CH	1.49
LM320K-5	1.95	LM709N	.49
LM320K-8	1.95	LM709CH	.49
LM320K-12	1.95	LM710N	.70
LM320K-15	1.95	LM711N	.49
LM320K-24	1.95	LM711CH	.49
LM320T-5	1.45	LM723N	.55
LM320T-8	1.45	LM723CH	.55
LM320T-12	1.45	LM725CH	3.25
LM320T-15	1.45	LM733N	1.00
LM320T-18	1.45	LM733H	1.29
LM323K-5	9.95	LM739N	1.29

★ LINEAR ★

LM741CH	.35	LM7525N	1.90
LM741CN	.35	LM7534N	2.20
LM747N	.75	LM7535N	1.25
LM747H	.75	75324	3.50
LM748H	.39	SG4501T	2.40
LM748N	.39	SG4501N	2.40
LM1414N	1.75	SG3524	8.95
LM1458CN	.65	RC4194T	6.95
LM1496N	.95	RC4195T	6.95
LM2111N	1.95	RC1458CN	.89
LM2901N	1.95	RC1556CN	.99
LM3065N	.69	RC3403AD	2.30
LM3900N	.55	RC4131CN	.99
LM3909	1.10	RC4136D	1.90
LM7520	2.25	RC4558CN	.99
LM7524N	1.75	RC4151CN	6.50
LU306K	.99	MC3302P	.75

★ 74LS00 TTL ★

For STD7400 and CMOS see previous ad.

74LS00	.22	LS32	.34
LS02	.24	LS40	.26
LS04	.24	LS42	1.10
LS05	.28	LS51	.26
LS08	.28	LS73	.56
LS10	.28	LS74	.56
LS13	.79	LS75	.79
LS14	1.69	LS76	.59
LS20	.26	LS83	1.69
LS27	.38	LS85	1.99
LS30	.26	LS86	.55

★ 74LS00 TTL ★

LS90	1.10	LS181	
LS92	1.10	LS190	2.49
LS93	1.10	LS191	2.49
LS95	1.69	LS192	2.49
LS107	.56	LS193	2.49
LS109	.56	LS194	2.49
LS112	.56	LS195	.52
LS113	.56	LS251	1.39
LS123	.99	LS253	1.49
LS132	1.10	LS257	1.29
LS136	.99	LS258	1.29
LS138	1.39	LS279	1.10
LS139	1.49	LS283	1.10
LS151	1.49	LS367	.99
LS153	1.29	LS368	.99
LS155	1.49	LS377	1.29
LS157	1.29	LS378	1.29
LS158	1.29	81LS95	1.10
LS161	1.39	81LS96	1.10
LS162	1.39	81LS97	1.10
LS163	1.39	81LS98	1.10
LS164	1.39	For standard 7400	
LS174	1.39	and CMOS see our	
LS175	1.39	previous. ad.	

★ UARTS ★

S1883	6.95	MM5320 TV Synch Gen	7.95
1602B	5.50	MM5369 Prescaler	3.95
AY51013A	5.50	MM5376 Calc Chip	2.95
AY51015A	9.95	CT5001 Calc Chip	2.95
S2350 USRT	9.95	CT7001 Clock Chip	5.95
1671B Astros	29.95	MM5314 Clock Chip	4.95
1482	13.95	MM5316 Clock Chip	4.95
1472	13.95	MM5375 Clock Chip	4.95

★ CONTINENTAL SPECIALTIES ★

OT PROTO STRIPS		PROTO BOARDS	
OT-59S	11.95	PB6	15.95
OT-47S	10.00	PB100	19.95
OT-35S	8.50	PB101	29.95
OT-18S	4.75	PB102	39.95
OT-12S	3.75	PB103	59.95
OT-8S	3.25	PB104	79.95
OT-7S	3.00	PB203	75.00
OT-59B	2.50	PB203A	120.00
OT-47B	2.25	Logic Probe	44.95
OT-35B	2.00	PC-14 Proto Clip	4.50
Experimentor 300	9.95	PC-16 Proto Clip	4.75
Experimentor 600	9.95		

All Shipments FEM or UPS. Orders under $100.00 add 5% handling & postage. Orders over $100.00 add 2.5% handling & postage. Mastercharge/Bankamericard/COD accepted w/25% deposit. California Residents add 6% tax. Foreign Orders add 8% handling.

★ SHIFT REGISTERS

MM500	$1.25
MM5013	2.95
MM5016	4.95
MM5017	2.95
P2405	5.95
N2518B	4.95
N2533	4.95
3341 FIFO	6.95
3347 FIFO	6.95
2841 FIFO	11.95
2812 FIFO	11.95
TMS3002LR	3.95
TMS3132NC	2.95
1402	3.95
1403	3.95
1404	3.95

★ DISPLAYS/LEDS

FND 357 (.375)	$1.25
FND 367 (.375)	1.35
FND 500 (.500)	1.25
FND 507 (.500)	1.00
FLV 110 Redled	5/1.00
FND 800 (.800)	2.50
FND 807 (.800)	2.50

TRANSISTORS

2N3904	5/$1.00
2N3906	5/$1.00
MPSA13	4/$1.00
2N2369	5/$1.00
2N2221	5/$1.00
2N3440	4/$1.00
2N5139	5/$1.00
2N5134	5/$1.00
2N4976 (RF power)	$9.95 ea.
2N3724A	4/$1.00
2N3495	$1.95
2N3702	4/$1.00
2N2484	3/$1.00
2N3766	2/$1.89
2N3692	5/$1.00
2N3055	$ .80
2N3771	$1.69
2N3772	$1.69
SPT410/DTS410	$ .99

ADVANCED ★ MICROCOMPUTER PRODUCTS

P. O. BOX 17329
Irvine, California 92713
New Phone (714) 558-8813

★ NOW Our First Store Open
1310 B Edinger
Santa Ana, CA 92705 ★

DAY OF THE WEEK PROGRAM JHDOTWP

by Jim Huffman

INTRODUCTION

Here is a day of the week program such as those used by financial people to determine the day of the week for any date since September 14, 1752, which is the date that England and its colonies switched from the Julian calendar to the Gregorian calendar. At that time, they suppressed several days which interrupted the continuity of the calendar. The Julian calendar was falling behind by three days every 400 years. There is a trap built into the program to determine whether you have entered the year before 1752, and if you have it will tell you so. If you enter a month before September, 1752, it will also tell you so, and if you enter a day before the 14th of September, 1752, the trap will inform you of your error. The trap is located in steps 31-38 of the program.

PROGRAM CONTROL

Note step 10; this program uses the control P and control V operators as control characters to home-up the cursor and erase the screen of my CT1024 terminal. This may have to be modified to suit your terminal. There are two basic subroutines, and a main routine that calls up the common Algorithms and then uses them in determining the values of the variables. Once the program determines the numeric value of the day of the week, 0-6 (with 0 equaling Sunday) then it determines the string value of that variable so the program prints the day of the week as string data rather than as numeric data.

Endless loop capability is provided in steps 280 and 290 so that you can find several days if you need them. There are 47 total statements, although statements 31-38 are optional and used for the trap which you need only under conditions explained above, i.e., if the operator enters any dates before September 14, 1752. The formula for the day of the week is given by

$$DAY = (n1 + N2 - N3 + N4 + D - 1) - 7 \times \text{Int}((N1 + N2 - N3 + N4 + D - 1))/7.$$

PROGRAM EXAMPLE

```
#RUN
(HOMEUP/ERASE)
ENTER MONTH, DAY, YEAR: IE 05,17,1945
?05,26,1946
SUNDAY

ANOTHER?YES

(HOMEUP/ERASE)
ENTER MONTH, DAY, YEAR: IE 05, 17, 1945
?09, 13, 1752
YOUR ENTRY IS BEFORE SEPTEMBER 14, 1752. RE-
ENTER MONTH, DAY, YEAR: IE 05,17,1945

ETC.
```

PROGRAM BASIC LISTING

```
0000 REM ****DAY OF WEEK PROGRAM
0001 REM PROGRAMMED BY J. HUFFMAN
0002 REM MICROCOMPUTER: SWTP 6800
0003 REM SUPPORT SOFTWARE: SWTP'S 8K BASIC
0004 REM MEMORY REQUIREMENTS:
0005 RESTORE
0010 PRINT ""
0020 PRINT "ENTER MONTH, DAY, YEAR :IE 05,17,1945"
0030 INPUT M,D,Y
0032 IF Y<1752 THEN PRINT "INVALID -PRE 1752"
0033 IF Y<>1752 THEN 100
0034 IF M>9 THEN 100
0035 IF M<9 THEN PRINT "INVALID--PRE SEPT 1752
0036 IF D>=14 GOTO 100
0037 PRINT "YOUR ENTRY IS BEFORE SEPT 14,1752 RE-ENTER"
0038 GOTO 20
0040 GOTO 100
0050 LET X=INT(.6+1/M)
0060 RETURN
0070 LET X=Y1/100
0080 RETURN
0100 GOSUB 50
0110  Y1=Y-X
0120  M1=M+12*X
0130 GOSUB 70
0140  N4=INT(X/4)
0150  N3=INT(X)
0160  N2=INT((5*Y1)/4)
0170  N1=INT(13*(M1+1)/5)
0190  X=N1+N2-N3+N4+D-1
0195  A=X-(7*INT(X/7))
0200 DATA 0,SUNDAY,1,MONDAY,2,TUESDAY,3,WEDNESDAY
0210 DATA 4,THURSDAY,5,FRIDAY,6,SATURDAY
0220 READ M,N$
0230 IF A<>M THEN 220
0240 PRINT
0250 PRINT N$
0260 PRINT
0270 RESTORE
0280 INPUT "ANOTHER (YES OR NO)",O$
0290 IF O$="YES" GOTO 10
0300 END
```

END***

MICROCOMPUTER

PROM'S

H-1024-5R	256 x 4 Bit 70 ns OC	4.25
1702A	256 x 8 Bit 1 us TS Erasable	5.00
1702AL	256 x 8 Bit 1 us TS Eras Lo Pwr	7.00
2704	512 x 8 Bit 450 ns TS Erasable	30.00
2708	1024 x 8 Bit 450 ns TS Erasable	30.00
5203AQ	256 x 8 Bit 1 us TS Erasable	9.00
5204AQ	512 x 8 Bit 1 us TS Erasable	12.00
HM7611-5	256 x 4 Bit 60 ns TS	3.25
74S287	256 x 4 Bit 65 ns TS	9.00
74S387	256 x 4 Bit 65 ns OC	9.00
82S23B	32 x 8 Bit 50 ns OC	4.00
82S129B	256 x 4 Bit 50 ns TS	4.25
8223B	32 x 8 Bit 50 ns OC	4.50

WAVEFORM GENERATOR

8038	VCO	4.50
MC4024	Dual VCO	2.75
566	VCO-Function	2.00

CHARACTER GENERATORS

2513	5x7 5 line CM2140 Upper case	6.75
MC6571AP	7x9 7 line	12.00
2431-1	CM3421 (Signetics)	5.00

SHIFT REGISTERS

DYNAMIC

1404AN	1024 x 1 Bit 2.5 MHz	3.00
2505K	512 x 1 Bit 2.5 MHz	3.00

STATIC

MM506	100 x 2 Bit	.89
2509K	50 x 2 Bit 1.5 MHz	1.00
2518B	32 x 6 Bit 2.0 MHz	3.95
2533V	1024 x 1 Bit 1.5 MHz	2.00
TMS3002	50 x 2 Bit 1.0 MHz	1.00
TMS3112	32 x 6 Bit 2.0 MHz	3.95
MM5058	1024 x b Bit 1.5 MHz (8 pin)	2.00

MISC OTHER COMPONENTS

NH0025CN	Dual Low Cost MOS Clock Driver	1.75
NH0026CN	5 MHz Dual MOS Clock Driver	3.00
N8T20	Bi-Directional One Shot	4.00
N8T26	Quad Bus Driver/Receiver	3.25
N8T97	Tri State Hex Buffer	1.45
DM8098	Tri State Hex Inverter	1.00
1488	RS232 Quad Line Driver	1.95
1489	RS232 Quad Line Receiver	1.95
D-3207A	Quad NAND to MOS Driver	2.50
C-3404	6 Bit Latch 12 ns O/P Delay	3.95
P-3408A	Tri State Hex MOS Sense Amp	6.75
P-4201	Clock Generator	4.95
MM-5320	T V Camera Sync Generator	6.00
MM-5369	Oscillator Pre-Scaler	2.00
DM-8130	Ten Bit Comparator	2.25
DM-8131	6 Bit Comparator	2.00
DM-8831	4 Input AND NAND Tri State	2.50
DM-8833	Quad Tri State Transceiver (True)	2.50
DM-8835	Quad Tri State Transceiver (Inv)	2.50

U A R T S

AY5-1013	(TR1602A) 30 KHz	6.95

C.P.U.'S

8008-1	8 Bit CPU	12.00
8080	Improved 8008	13.95
8080A	Super 8008	16.95
Z80	CPU (3880)	39.95
F8	CPU (3850)	29.95

Support Devices

3851	Program Storage Unit (F-8)	19.95
3853	Static Memory Interface (F-8)	19.95
3881	Parallel I/O Controller (Z-80)	19.95
3882	Counter Timer Circuit (Z-80)	19.95
8212	8-Bit I/O Port	4.25
8214	PriorityInterrupt Control	12.95
8216	Bi-Directional Bus Driver	5.25
8224	Clock, Generator & Driver	6.00
8228	System Controller & Bus Driver	9.25
8251	Programmable Communication Int	12.00
8255	Programmable Peripheral Interface	12.00
8257	Progr Direct Mem Access Control	23.90
8259	Progr Interrupt Controller	20.00

DYNAMIC RAMS

1103	1024 x 1 Bit 300 ns	1.50
2107A	4096 x 1 Bit 300 ns	6.00
2107B	4096 x 1 Bit 200 ns	6.50
2107B-4	4096 x 1 Bit 270 ns	5.00
2107B-6	4096 x 1 Bit 350 ns	4.50
4008P-6	1024 x 1 Bit 500 ns	2.75
4050NL	4096 x 1 Bit 300 ns	4.00
MM5261	1024 x 1 Bit 400 ns	3.00
MM5262	2048 x 1 Bit 365 ns	3.00
MM5270	4096 x 1 Bit 200 ns (18 pin)	4.00
MM5280	4096 x 1 Bit 200 ns (22 pin)	6.00

STATIC RAMS

21L02-1	1024 x 1 Bit 500 ns TS	1.75
31L01	16 x 4 Bit 110 ns OC	2.00
1101A	256 x 1 Bit 1 us TS	1.00
2101	256 x 4 Bit 1 us TS	3.00
2102	1024 x 1 Bit 1 us TS	1.50
2102-1	1024 x 1 Bit 500 ns TS	1.65
2111A-4	256 x 4 Bit 450 ns TS (18 pin)	3.45
2112A-4	256 x 4 Bit 450 ns TS (16 pin)	2.45
2501B	256 x 1 Bit 1 us	1.45
3107	256 x 1 Bit 80 ns OC	2.95
74C89	16 x 4 Bit 280 ns TS	3.00
74S201	256 x 1 Bit 50 ns TS	4.75
91L02A	1024 x 1 Bit 500 ns TS	2.00
7489	16 x 4 Bit 60 ns OC	2.25
8225	16 x 4 Bit 50 ns OC	1.50
8599	16 x 4 Bit 50 ns TS	1.50

FIFO

3341A	64 x 4 Bit 1.0 MHz	6.75

U A R T S

6.95

JADE CO. OFFERS

THE ITEMS SHOWN IN THIS AD FOR IMMEDIATE SHIPMENT FROM STOCK. IN ADDITION WE STOCK OVER 4,000 OTHER ITEMS. INCLUDING:

1. All Standard, Hi-Speed, Low Power, Schottky TTL Product
2. All Linear Devices
3. Transistors—Diodes
4. Clock Kits & Modules
5. Vectors & AP Products
6. Resistors-Capacitors
7. Video Games & Chips
8. PROM Setters [E-Prom]
9. Wire & Wire Wrap Tools

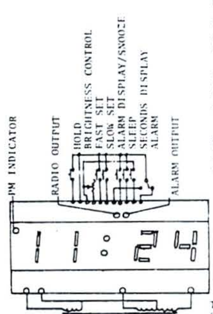
SPECIAL OF THE MONTH

2708 E-PROM
Price $30.00 ea.

master charge THE INTERBANK CARD

your BANKAMERICARD welcome

Digital Clock Module

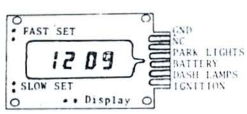


FEATURES
*4-digit 0.5 display
*Complete, needs only transformer & switches
*Clock Radio Alarm
*12 hr & 60Hz
*Power Failure Indicator
*Direct Drive-No RFI

APPLICATIONS
*Clock radio timers
*Desk Clocks
*Instrument panel clocks

MA 1002 A
$10. 95

TRANSFORMER, 14 VCT AC SCHEMATIC TO POWER MA 1002A $1.75

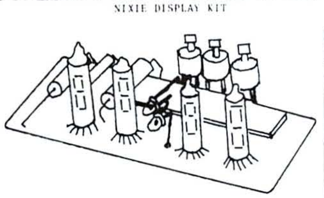


FEATURES
* Operates on 9-12 V DC
* 0.3" green display
* Internal time base
* Display color filterable to blue, green & yellow
* Lock out of time set when display is "OFF"

APPLICATIONS
* In dash autoclocks
* Recreation vehicles
* Aircraft/Marine clocks
* Portable battery operated instruments

MA 1003
$24. 95

NIXIE DISPLAY KIT



FEATURES
* MM5316 Clock Chip
*Needs only case & 12 V AC @ 200 ma
*Blanking control
*AM PM Option
*24 hr Capability
*59 minute timer
*Power Failure indicator
*24 hr clock radio

NIXIE CLOCK KIT
$12. 95
Transformer 110-14V AC 200ma $1.50

TIME BASE CHIP

MM 5369	17 Stage Osc/Divider	2.00

CLOCK CHIPS

MM5312N	4 Digit w/BCD-7 Seg 12/24 hr 50/60 Hz	4.50
MM5316N	4 Digit Alarm-Snooze, 12/24 59 min timer, 50/60 Hz, AM/PM	4.00
MM5318N	TV Display Digital Clock	8.95
MM5370N	Gas Discharge Display 12/24 60" Hz, 59 min timer, AM/PM	4.00
MM5375NAC	4/6 digit, date counter, 50Hz	2.00
7001	6 digit calender, alarm, 12/24 hr	5.95

74LS00

Low Power Schottky

74LS00	.40
74LS02	.40
74LS03	.40
74LS04	.40
74LS05	.40
74LS08	.40
74LS10	.40
74LS11	.40
74LS12	.50
74LS20	.40
74LS21	.40
74LS30	.40
74LS32	.40
74LS37	.50
74LS42	.90
74LS51	.40
74LS73	.60
74LS74	.65
74LS76	.60
74LS78	.80
74LS85	2.00
74LS86	.55
74LS95	2.00
74LS107	.55
74LS109	.60
74LS112	.60
74LS113	.60
74LS122	.60
74LS139	1.30
74LS151	1.50
74LS153	1.60
74LS155	1.60
74LS157	1.30
74LS161	1.50
74LS169	2.00
74LS174	1.25
74LS175	1.30
74LS191	2.45
74LS192	1.95
74LS193	2.45
74LS196	2.60
74LS248	1.35
74LS251	2.00
74LS266	.75
74LS363	.70
74LS367	1.00
74LS368	1.00
74LS386	.75

CMOS

34001	Quad 2-Input NOR Gate	.40
4000	Dual 3-Input NOR Gate/Inver	.25
4001	Quad 2-Input NOR Gate	.25
4002	Dual 4 Input NOR Gate	.25
4004	7 Stage RPL Ctr/hz Div.	3.50
4006	18 Bit St. Shift Register	1.40
4007	Dual Comp Pair + Inverter	.25
4008	4-Bit Full Adder	1.25
4009	Hex Buffer Inverter	.70
4010	Hex Buffer Converter	.70
4011	Quad 2-Input NAND Gate	.25
4012	Dual 4 Input NAND Gate	.25
4013	Dual Type D Flip Flop	.60
4014	8 Bit St. Shift Register	1.25
4015	Dual 4-Bit Static Shift Reg	1.25
4016	Quad Analog SW/Quad Multi	.60
4017	Decade Counter/Divider	1.25
4018	Divide By N Counter	1.25
4019	Quad AND-OR select Gate	.70
4020	14 Bit Binary Counter	1.25
4021	8 Bit St. Shift Register	1.25
4022	Octal Counter/Divider	1.25
4023	Triple 3-Input NAND Gate	.35
4024	7-Stage Ripple Counter	1.00
4025	Triple 3-Input NOR Gate	.35
4026	Decade Ctr/Div 7 Seg Output	2.25
4027	Dual J-K Flip Flop	.60
4028	BCD to Dec. Bi. Octal Dec	1.25
4029	4 Bit BIN/BCD UP/DN CTR	1.90
4030	Quad Exclusive OR Gate	.60
4032	Triple Serial Adder (POS)	1.60
4033	Decade Ctr/Div 7 Seg Out W/B	2.00
4034	8-Bit Universal Bus Register	3.50
4035	4 Bit Shift Register	1.60
4038	Triple Serial Adder (Neg)	1.60
4040	12 Bit Binary Counter	1.50
4041	Quad True/Comp Buffer	1.45
4042	Quad Latch	1.25
4043	Quad 3 State NOR R/S Latch	1.20
4044	Quad 3 State NAND R/S Latch	1.25
4046	Phase-Locked Loop	1.95
4047	Mono/Astable Mltvbr	2.50
4049	Hex Inverter/Buffer	.75
4050	Hex Non Inverting Buffer	.75
4051	8 Channel Analog Multiplexer	1.10
4052	Dif 4 Channel Analog Mx.	1.10
4053	Triple 2 Channel Mltplx	1.10
4060	14 Stage Binary Ctr/Osc	3.25
4061	256 x 1 Static RAM	7.00
4063	4-Bit Magnitude Comparator	2.50
4066	Quad Bilateral Sw.	.85
4068	8-Input NAND Gate	.38
4069	Hex Inverter	.40
4070	Quad Excl OR Gate	.38
4071	Quad 2 Input OR Gate	.38
4072	Dual 4 Input OR Gate	.38
4073	Triple 3 Input AND Gate	.38
4075	Triple 3 Input OR Gate	.38
4076	Quad D Type Register	1.85
4078	8-Input NOR Gate	.38
4081	Quad 2 Input AND Gate	.38
4082	Dual 4-Input AND Gate	.38
4093	Quad 2-1 NAND Schmitt Trigger	.75
4098	Dual Retrig/Reset M S Multi	2.50
4160	Decade Counter	1.75
4161	Binary Counter	1.75
4162	Decade Counter	1.75
4163	Binary Counter	1.75
4174	Hex D Flip-Flop	1.75
4175	Quad D Flip-Flop	1.60
4194	4-Bit Univ Shift Register	1.80
4501	Triple Gate	.38
4502	Strobed Hex Inverter/Buffer	1.75
4503	Hex Three State Buffer	1.15
4506	Dual Expandable AOI Gate	.70
4507	Quad Exclusive OR Gate	1.00
4508	Dual 4-Bit Latch	4.00
4510	BCD Up/Down Counter	1.75
4511	BCD to 7 Seg Latch/Decdr/Dr	2.00
4512	8 Channel data selector	1.50
4514	4/16 line decoder (hi)	4.75
4515	4/16 line decoder (lo)	4.75
4516	Binary up/down counter	1.75
4517	Dual 64-Bit Static Shift Reg	8.50
4518	Dual 4-Bit Decade Counter	1.65
4519	4 Bit AND/OR Selector	.90
4520	Dual 4-Bit Binary Counter	1.65
4521	24 State Frequency Divider	3.25
4522	BCD Divide by N-Counter	1.75
4527	BCD Rate Multiplier	3.00
4528	Dual Monostable Mltvbr	1.75

CONNECTORS

EDGE CONNECTORS

10	Dual .156 W W Gold	.50
15	Dual .156 W W Gold	.75
22	Dual .156 Solder Gold	2.25
50	Dual .125 Solder Gold	5.00
50	Dual .125 Solder Gold (No Bolt Down Ears)	3.50
10	Molex type w/edge clip female & male (solder)	10/1.25

SUBMINITURE

25	Solder type (25-S) (Female)	3.90
25	Solder type (25-P) (Male)	3.50
	Male & female (25-P & 25-S)	6.50
	Cover each	1.50

SOCKETS

I C SOCKETS

Pins	Description	Price
8	Lo Pro Tin	.20
10	Transistor IC-10) Gold	.25
14	Lo Pro Tin	.25
14	Wire Wrap Gold	.30
16	Lo Pro Tin	.25
16	Standard P C Tin	.30
16	Wire Wrap Tin	.30
18	Lo Pro Tin	.25
22	Lo Pro Open Frame Tin	.50
22	Wire Wrap Tin	.95
24	Standard P C Tin	.50
24	Wire Wrap Tin	.85
28	Lo Pro (Open Frame) Tin	.40
28	Standard P C Tin	.60
28	Wire Wrap Tin	.95
40	Lo Pro (Open Frame) Tin	.50
40	Wire Wrap Tin	1.45

JADE CO

Electronics for the Hobbiest and Experimenter

5351 WEST 144th STREET
LAWNDALE, CALIFORNIA 90260
(213) 679-3313

CIRCLE INQUIRY NO. 98

"STAR LANES"
A NON-PROGRAMMER WRITES A COMPUTER GAME
by Steven Faber

INTRODUCTION

Since I had no significant background in programming, I spent the year or so since completing my Altair 8800 writing simple programs on the order of computing the current value of a stock portfolio, bidding jobs for my company, or calculating my mortgage. I left the game-writing programs to the "whiz kids." You publish them; I'll type them in. When not playing with my own simple programs, I spent my time entering, modifying and playing existing game programs. I exhausted the national magazines, anthologies and other publications. It would only be a matter of time, I assured myself, given the population explosion of amateur programmers, until the new, original, complex game programs found their way to publication. Alas, this has not been the case. Where are the new Star Treks, Star Traders, etc.? In retaliation, I decided to attempt a new game of my own. Hence, Star Lanes, printed here.

The game of Star Lanes is written in Altair 8K BASIC Version 3.2. If the instructions are deleted, it will run on about 7K on top of BASIC. It can be crunched smaller if the matrices are trimmed to allow only two players.

Star Lanes combines financial and position strategies as players attempt to lay claim to valuable pieces of real estate between stars. The galaxy in this game is a 9 x 12 matrix. As spaces are linked up, shipping companies are formed, stock in those companies is issued, sold on the open market, and converted into stock in the surviving company when companies are merged. As the game progresses, each player's portfolio of stock increases in value. At the end of the game, the wealthiest player wins (See the instructions in the sample run, below).

HOW THE PROGRAM WORKS

An abbreviated flow chart is included here. Access to the portfolio and map print-out subroutines at the input statements has been left out for the sake of clarity.

LINES 100-130: Initializes the galactic matrix, M(I,J). Stars are placed in approximately one out of every twenty spaces, using the RND function.

LINES 130-170: Initializes player roster, decides first player to move, and branches to LINE 220.

LINES 200-210: Counts moves and changes players. If the move counter shows 48 completed moves, program branches to LINE 9500, where final scores are computed and printed.

LINES 220-340: Selects five "Legal Moves" for the player to select, using the RND function. The logic for deciding which moves are legal is shown in the expanded flow chart, Figure 2.

LINES 340-390: Prints the map, offers legal moves to player, and inputs player's selected move.

LINES 400-790: Assigns value to selected space to identify it in the galactic matrix. Numerical assignments are made as follows:

M(I,J) = 1 Space is unoccupied
= 2 Space is unattached outpost
= 3 Space is a star
= 4 Space is assigned to Altair Starways
= 5 Space is assigned to Betelgeuse, Ltd.
= 6 Space is assigned to Capella Freight Co.
= 7 Space is assigned to Denebola Shippers
= 8 Space is assigned to Eridani Expediters

Program first checks to see if the selected space should be an unattached outpost i.e., having no adjacent occupied spaces, then program checks to see if the new space causes a merger. If so, it branches to subroutine at LINE 1060. Program then checks to see if selected space adds to an existing shipping lane. If so, it recomputes the value of the stock in that company. If the selected space forms a new company, computer assigns value to the stock of the new company, assigns a name to the company and awards five shares of stock to the player. Lastly, the value of the stock is checked to see if it is to be split. If so, program branches to subroutine at line 1400.

LINE 800: Computes and awards dividends to player.

LINES 810-900; Stock Market. Player is offered stock in all active shipping companies. If he buys, the cost of the stock is deducted from his bank balance. Program then branches back to LINE 200.

SUBROUTINES

LINES 1000-1050: Prints the map.

LINES 1060-1170: Calculates which company is the survivor in a merger.

LINES 1180-1370: Performs calculations needed to accomplish merger. Prints announcement of merger, conversion of stock, and cash bonus paid each player. New stock value is checked to see if stock should be split. If so, program branches to subroutine at LINE 1400. Lastly, smaller company is cleared from the records, so that a new company may be formed later in the game.

LINES 1400-1480: Calculates Stock Splits.

LINES 8000-8760: Prints the instructions.

LIST OF VARIABLES USED IN STAR LANES

M(R,C) = Galactic Matrix where R (1-9) is the row, and C (1-12) is the column of a given space.

S(I,J) = Quantity of Stock matrix where I (1-5) is the number of the shipping company and J is the player number.

D1(I) = Stores the net worth of each player.

S1(I)	=	Stock price for company #I.
Q(I)	=	Number of spaces occupied by company #I.
B(I)	=	Cash in bank for Player #I.
M$(I)	=	Prints name of company #I.
M$	=	Prints column designation (A-L) where 1 = A, 2 = B, etc.
L$(I)	=	Prints space designation on galactic map, where I = 1-8. Uses same numerical assignments as the galactic matrix, i.e., 1 = empty space, 2 = unattached outpost, etc. (See text).
R$, R3$	=	Input string for player response.
P$(I)	=	Prints name of player #I.
P1	=	Number of players.
P	=	# of player this turn.
I,J,I3,J3	=	For, next loop variables.
K	=	Counts moves.
R(I),C(I)	=	Stores row, column designation of computer offered legal moves.

A1,A2,A3,A4,R3,R2,C2,F1,F2,F3,F4,T,T1,X,X1 = *Temporary variables.*

MICROCOMPUTER INSTRUCTIONS

How many players (2-4)? 2
Does any player need instructions? Yes.

Star Lanes is a game of interstellar trading. The object of the game is to amass the greatest amount of money. This is accomplished by establishing vast, interstellar shipping lanes, and purchasing stock in the companies that control those trade routes. During the course of the game, stock appreciates in value as the shipping companies become larger. Also, smaller companies can be merged into larger ones, and stock in the smaller firm is converted into stock in the larger one.

Each turn, the computer will present the player with five prospective spaces to occupy on a 9 x 12 matrix (Rows 1-9, Columns A-L). The player, after examining the map of the Galaxy to decide which space he wishes to occupy, responds with the row and column of that space, 1.E., 7E, 8A, etc. There are four possible moves a player can make.

1. He can establish an unattached outpost — if he selects a space that is not adjacent to a star, another unattached outpost, or an existing shipping lane, this space will be designated with a '+'. He will then proceed with stock transactions.

2. He can add to an existing lane. If he selects a space which is adjacent to one — and only one existing shipping lane, the space he selects will be added to that shipping lane, and will be designated with the first letter of the company that owns that lane. If there are any stars or unattached outposts also adjacent to the selected space, they, too, will be incorporated into the existing lane. Each new square adjacent to a star adds $500 per share, and each new outpost adds $100 per share to the market value of the stock of that shipping company.

3. He may establish a new shipping lane. If there are five or less existing shipping lanes established, the player may, given the proper space to play, establish a new shipping lane. He may do this by occupying a space adjacent to a star of another unattached outpost, but not adjacent to an existing shipping lane. If he establishes a new shipping lane, he is automatically issued 5 shares in the new company as a reward. He may then proceed to buy stock in that company, or any other active company, as described below. The market value of the new stock is established by the number of stars and occupied spaces as described in #2 above.

4. He may merge two existing companies. If player selects a space adjacent to two existing shipping lanes, a merger occurs. The larger company takes over the smaller company; the stock of the larger company is increased in value according to the number of spaces and stars added to its lane. Each player's stock in the smaller company is exchanged for shares in the larger on a ratio of 2 shares of the smaller = 1 share of the larger. Also, each player is paid a cash bonus proportional to the percentage of outstanding stock he held in the smaller company. Note: after a company becomes defunct through this merger process, it can reappear elsewhere on the board if a new company is established (see #3 above).

Next the computer adds the stock dividends to the player's cash on hand (5% of the market value of the stock in his possession), and offers him the opportunity to purchase stock in any of the active companies on the board. Stock may not be sold, but the market value of each player's stock is taken into account at the end of the game to determine the winner. If the market value of a given stock exceeds $3000 at any time during the game, that stock splits two for one. The price is cut in half, and the number of shares owned by each player is doubled.

Note: the player may look at his portfolio at any time during the course of his turn by responding with "Stock" to an input statement. Likewise, he can review the map of the galaxy by typing "Map" to an input statement.

Game ends after 48 moves. Player with the greatest net worth at that point is the winner.

RUNNING STAR LANES

Player 1 What is your name? Steve.
Player 2 What is your name? Debbie.
Now I will decide who goes first . . .
Steve is the first player to move.

```
        MAP OF THE GALAXY
   A  B  C  D  E  F  G  H  I  J  K  L
1  •  •  •  •  •  •  •  •  •  •  •  •
2  •  •  •  •  •  •  •  •  •  •  •  •
3  •  •  •  •  •  •  •  •  •  •  •  *
4  •  •  •  •  •  •  •  •  •  •  •  •
5  •  •  •  •  •  *  •  •  •  •  •  •
6  •  •  •  •  •  •  •  •  •  •  •  •
7  •  •  •  •  •  •  •  •  •  *  •  •
8  •  •  •  •  •  •  •  •  •  •  •  •
9  •  •  •  •  •  •  •  •  •  •  •  •
```

Steve, here are your legal moves for this turn: 4 g / 4 i / 7 d / 9 f / 6 b /
What is your move? 6b

```
        MAP OF THE GALAXY
   A  B  C  D  E  F  G  H  I  J  K  L
1  •  •  •  •  •  •  •  •  •  •  •  •
2  •  •  •  •  •  •  •  •  •  •  •  •
3  •  •  •  •  •  •  •  •  •  •  •  *
4  •  •  •  •  •  •  •  •  •  •  •  •
5  •  •  •  •  •  *  •  •  •  •  •  •
6  •  +  •  •  •  •  •  •  •  •  •  •
7  •  •  •  •  •  •  •  •  •  *  •  •
8  •  •  •  •  •  •  •  •  •  •  •  •
9  •  •  •  •  •  •  •  •  •  •  •  •
```

Debbie, here are your legal moves for this turn: 4 d / 9 f / 9 e / 3 e / 9 l /
What is your move? 3e

```
        MAP OF THE GALAXY
   A  B  C  D  E  F  G  H  I  J  K  L
1  •  •  •  •  •  •  •  •  •  •  •  •
2  •  •  •  •  •  •  •  •  •  •  •  •
3  •  •  •  •  +  •  •  •  •  •  •  *
4  •  •  •  •  •  •  •  •  •  •  •  •
5  •  •  •  •  •  *  •  •  •  •  •  •
6  •  +  •  •  •  •  •  •  •  •  •  •
7  •  •  •  •  •  •  •  •  •  *  •  •
8  •  •  •  •  •  •  •  •  •  •  •  •
9  •  •  •  •  •  •  •  •  •  •  •  •
```

Steve, here are your legal moves for this turn: 8 i / 1 f / 5 j / 9 l / 4 c /
What is your move? 9 l

```
        MAP OF THE GALAXY
   A  B  C  D  E  F  G  H  I  J  K  L
1  •  •  •  •  •  •  •  •  •  •  •  •
2  •  •  •  •  •  •  •  •  •  •  •  •
3  •  •  •  •  +  •  •  •  •  •  •  *
4  •  •  •  •  •  •  •  •  •  •  •  •
5  •  •  •  •  •  *  •  •  •  •  •  •
6  •  +  •  •  •  •  •  •  •  •  •  •
7  •  •  •  •  •  •  •  •  •  *  •  •
8  •  •  •  •  •  •  •  •  •  •  •  •
9  •  •  •  •  •  •  •  •  •  •  •  +
```

Debbie, here are your legal moves for this turn: 5 l / 5 c / 2 k / 1 b / 2 e /
What is your move? 2 e

Special Announcement!!
A new shipping company has been formed!
Its name is Altair Starways.

Your current cash = \$6050.
Buy how many shares of Altair Starways at \$200.
You now own 5 ? 10.

```
        MAP OF THE GALAXY
   A  B  C  D  E  F  G  H  I  J  K  L
1  •  •  •  •  •  •  •  •  •  •  •  •
2  •  •  •  •  A  •  •  •  •  •  •  •
3  •  •  •  •  A  •  •  •  •  •  •  *
4  •  •  •  •  •  •  •  •  •  •  •  •
5  •  •  •  •  •  *  •  •  •  •  •  •
6  •  +  •  •  •  •  •  •  •  •  •  •
7  •  •  •  •  •  •  •  •  •  *  •  •
8  •  •  •  •  •  •  •  •  •  •  •  •
9  •  •  •  •  •  •  •  •  •  •  •  +
```

Steve, here are your legal moves for this turn: 9 k / 3 f / 5 j / 4 i / 1 e /
What is your move? 9 k

Special Announcement!!
A new shipping company has been formed!
Its name is Betelgeuse, Ltd.

Your current cash = \$6050.
Buy how many shares of Altair Starways at \$200.
You now own 0 ? 2.
Your current cash = \$5650.
Buy how many shares of Betelgeuse, Ltd. at \$200.
You now own 5 ? 8.

```
        MAP OF THE GALAXY
   A  B  C  D  E  F  G  H  I  J  K  L
1  •  •  •  •  •  •  •  •  •  •  •  •
2  •  •  •  •  A  •  •  •  •  •  •  •
3  •  •  •  •  A  •  •  •  •  •  •  *
4  •  •  •  •  •  •  •  •  •  •  •  •
5  •  •  •  •  •  *  •  •  •  •  •  •
6  •  +  •  •  •  •  •  •  •  •  •  •
7  •  •  •  •  •  •  •  •  •  *  •  •
8  •  •  •  •  •  •  •  •  •  •  •  •
9  •  •  •  •  •  •  •  •  •  •  B  B
```

Debbie, here are your legal moves for this turn: 9 e / 7 b / 1 c / 2 j / 3 k /
What is your move? 3k

Special Announcement!!
A new shipping company has been formed!
Its name is Capella Freight Co.
Time passes. There are now 5 shipping companies active.

Your current cash = \$810.
Buy how many shares of Altair Starways at \$200.
You now own 16 ? 1.
Your current cash = \$610.

Buy how many shares of Betelgeuse, Ltd. at $200.
You now own 17 ? 0.
Your current cash = $610.
Buy how many shares of Capella Freight Co. at $600.
You now own 1 ? 0.
Your current cash = $610.
Buy how many shares of Denebola Shippers at $200.
You now own 0 ? 0.
Your current cash = $610.
Buy how many shares of Eridani expediters at $600.
You now own 5 ? 1.

MAP OF THE GALAXY

	A	B	C	D	E	F	G	H	I	J	K	L
1	●	●	●	●	●	●	●	●	●	●	●	●
2	●	●	●	●	A	●	●	●	●	●	●	●
3	●	●	●	●	A	●	+	●	●	●	C	*
4	+	●	●	●	●	●	●	●	●	●	●	●
5	●	●	●	●	●	*	●	●	●	●	●	●
6	●	D	D	●	●	●	●	●	●	●	●	●
7	●	●	●	●	●	●	●	●	E	*	●	●
8	●	●	+	●	●	●	●	●	●	●	●	●
9	●	●	●	●	●	●	●	●	●	●	B	B

Debbie, here are your legal moves for this turn: 5 b / 7 l / 3 j / 4 j / 9 a /
What is your move? 3 j
Your current cash = $695
Buy how many shares of Altair Starways at $200.
You now own 22 ? Stock

Stock	Price Per Share	Your Holdings
Altair Starways	200	22
Betelgeuse, Ltd.	200	8
Capella Freight Co.	700	9
Denebola Shippers	200	5
Eridani Expediters	600	0

Buy how many shares of Altair Starways at $200.
You now own 22 ? 0.
Your current cash = $695.
Buy how many shares of Betelgeuse, Ltd. at $200.
You now own 8 ? 0.
Your current cash = $695.
Buy how many shares of Capella Freight Co. at $700.
You now own 9 ? 0.
Your current cash = $695.
Buy how many shares of Denebola Shippers at $200.
You now own 5 ? 3.
Your current cash = $95.
Buy how many shares of Eridani Expediters at $600.
You now own 0 ? 0.
More time passes.

MAP OF THE GALAXY

	A	B	C	D	E	F	G	H	I	J	K	L
1	●	+	●	A	●	●	●	●	●	●	●	●
2	●	●	●	A	A	●	●	●	●	C	C	●
3	●	●	●	A	A	●	+	●	C	C	C	*
4	+	●	D	●	●	●	●	●	●	●	●	●
5	●	●	D	D	●	*	●	●	●	●	●	●
6	●	D	D	●	●	●	●	●	●	●	●	●
7	●	●	D	●	●	●	●	●	E	*	●	●
8	●	●	D	●	●	●	●	●	●	B	B	B
9	●	●	●	●	●	●	●	●	●	●	B	B

Steve, here are your legal moves for this turn: 8 i / 6 e / 6 l / 1 h / 4 h /
What is your move? 8 i

Special announcement!!
Eridani Expediters has just been merged into Betelgeuse, Ltd.! Please note the following transactions.
Old Stock = Eridani Expediters
New Stock = Betelgeuse, Ltd.

Player	Old Stock	New Stock	Total Holdings	Bonus Paid
Steve	7	4	25	$6000
Debbie	0	0	9	$0

Your current cash = $9520.
Buy how many shares of Altair Starways at $500.
You now own 24 ? 2.
Your current cash = $8520.
Buy how many shares of Betelgeuse, Ltd. at $1600.
You now own 25 ? 0.
Your current cash = $8520.
Buy how many shares of Capella Freight Co. at $1000.
You now own 1 ? 3.
Your current cash = $5520.
Buy how many shares of Denebola Shippers at $700.
You now own 9 ? 7.

MAP OF THE GALAXY

	A	B	C	D	E	F	G	H	I	J	K	L
1	●	+	●	A	●	●	●	●	●	●	●	●
2	●	●	●	A	A	●	●	●	●	C	C	●
3	●	●	●	A	A	●	+	●	C	C	C	*
4	+	●	D	●	●	●	●	●	●	●	●	●
5	●	●	D	D	●	*	●	●	●	●	●	●
6	●	D	D	●	●	●	●	●	●	●	●	●
7	●	●	D	●	●	●	●	●	B	*	●	●
8	●	●	D	●	●	●	●	●	B	B	B	B
9	●	●	●	●	●	●	●	●	●	●	B	B

Betelgeuse has taken over Eridani.

MAP OF THE GALAXY

	A	B	C	D	E	F	G	H	I	J	K	L
1	D	D	D	D	●	●	●	●	●	●	●	●
2	●	●	●	D	D	D	D	●	●	D	D	D
3	●	●	●	D	D	●	D	D	D	D	D	*
4	+	●	D	D	D	D	D	●	●	●	D	●
5	●	●	D	D	●	*	D	●	●	●	D	●
6	●	D	D	D	●	●	●	●	●	D	D	●
7	●	●	D	D	●	●	●	●	B	*	●	●
8	●	●	D	●	●	●	●	B	B	B	B	B
9	●	●	●	●	●	●	●	●	●	●	B	B

It is near the end of the game, now. Denebola has absorbed almost every other shipping company.

Debbie, here are your legal moves for this turn: 2 a / 3 a / 1 l / 9 f / 6 f /
What is your move? 6 f

Special Announcement!!
A new shipping company has been formed!
Its name is Altair Starways.

Your current cash = $52856.
Buy how many shares of Altair Starways at $600.
You now own 5 ? 25.
Your current cash = $37856.
Buy how many shares of Betelgeuse, Ltd. at $1700.
You now own 53 ? 15.
Your current cash = $12356.
Buy how many shares of Denebola Shippers at $2475.
You now own 379 ? 5.

DIODES/ZENERS

1N914	100v	10mA	.05
1N4004	400v	1A	.08
1N4005	600v	1A	.08
1N4007	1000v	1A	.15
1N4148	75v	10mA	.03
1N753A	6.2v	z	.25
1N758A	10v	z	.25
1N759A	12v	z	.25
1N4733	5.1v	z	.25
1N5243	13v	z	.25
1N5244B	14v	z	.25
1N5245B	15v	z	.25

SOCKETS/BRIDGES

8-pin	pcb	.25	ww	.45
14-pin	pcb	.25	ww	.40
16-pin	pcb	.25	ww	.40
18-pin	pcb	.25	ww	.75
22-pin	pcb	.45	ww	1.25
24-pin	pcb	.35	ww	1.25
28-pin	pcb	.35	ww	1.45
40-pin	pcb	.50	ww	1.95

Molex pins .01 To-3 Sockets .25

2 Amp Bridge 100-prv 1.20

25 Amp Bridge 200-prv 1.95

TRANSISTORS, LEDS, etc.

2N2222	NPN			.15
2N2907	PNP			.15
2N3740	PNP	1A	60v	.25
2N3906	PNP			.10
2N3054	NPN			.35
2N3055	NPN	15A	60v	.50
T1P125	PNP	Darlington		.35

LED Green, Red, Clear .15

D.L.747 7 seg 5/8" high com-anode 1.95

XAN72 7 seg com-anode 1.50

FND 359 Red 7 seg com-cathode 1.25

C MOS

4000	.15
4001	.20
4002	.20
4004	3.95
4006	1.20
4007	.35
4008	1.20
4009	.30
4010	.45
4011	.20
4012	.20
4013	.40
4014	1.10
4015	.95
4016	.35
4017	1.10
4018	1.10
4019	.70
4020	.85
4021	1.35
4022	.95
4023	.25
4024	.75
4025	.35
4026	1.95
4027	.50
4028	.95
4030	.35
4033	1.95
4034	2.45
4035	1.25
4040	1.35
4041	.69
4042	.95
4043	1.25
4044	.95
4046	1.50
4049	.80
4050	.60
4066	1.35
4069	.40
4071	.35
4082	.45

— T T L —

7400	.15
7401	.15
7402	.20
7403	.20
7404	.15
7405	.25
7406	.35
7407	.55
7408	.25
7409	.15
7410	.10
7411	.25
7412	.30
7413	.45
7414	1.10
7416	.25
7417	.40
7420	.15
7426	.30
7427	.45
7430	.15
7432	.30
7437	.35
7438	.35
7440	.25
7441	1.15
7442	.55
7443	.85
7444	.45
7445	.80
7446	.95
7447	.95
7448	.95
7450	.25
7451	.25
7453	.20
7454	.25
7460	.40
7470	.45
7472	.45

7473	.25
7474	.35
7475	.35
7476	.30
7480	.55
7481	.75
7483	.95
7485	.95
7486	.30
7489	1.35
7490	.55
7491	.95
7492	.95
7493	.40
7494	1.25
7495	.60
7496	.80
74100	1.85
74107	.35
74121	.35
74122	.55
74123	.55
74125	.45
74126	.35
74132	1.35
74141	1.00
74150	1.00
74151	.75
74153	.95
74154	1.05
74156	1.15
74157	.65
74161	.85
74163	.95
74164	.60
74165	1.50
74166	1.35
74175	.80

74176	1.25
74180	.85
74181	2.75
74182	.95
74190	1.75
74191	1.35
74192	1.65
74193	.85
74194	1.25
74195	.95
74196	1.25
74197	1.25
74198	2.35
74221	1.00
74367	.85
75108A	.35
75110	.35
75491	.50
75492	.50
74H00	.25
74H01	.25
74H04	.25
74H05	.25
74H08	.35
74H10	.35
74H11	.25
74H15	.30
74H20	.30
74H21	.25
74H22	.40
74H30	.25
74H40	.25
74H50	.25
74H51	.25
74H52	.15
74H53J	.25
74H55	.25

74H72	.55
74H101	.75
74H103	.75
74H106	.95
74L00	.35
74L02	.35
74L03	.30
74L04	.35
74L10	.35
74L20	.35
74L30	.45
74L47	1.95
74L51	.45
74L55	.65
74L72	.45
74L73	.40
74L74	.45
74L75	.55
74L93	.55
74L123	.55
74S00	.55
74S02	.55
74S03	.40
74S04	.35
74S05	.35
74S08	.35
74S10	.35
74S11	.35
74S20	.35
74S40	.25
74S50	.25
74S51	.45
74S64	.25
74S74	.40
74S112	.90
74S114	1.30

74S133	.45
74S140	.75
74S151	.35
74S153	.35
74S157	.80
74S158	.35
74S194	1.05
74S257 (8123)	.25
74LS00	.45
74LS01	.45
74LS02	.45
74LS04	.45
74LS05	.55
74LS08	.45
74LS09	.45
74LS10	.45
74LS11	.45
74LS20	.40
74LS21	.25
74LS22	.25
74LS32	.40
74LS37	.40
74LS40	.55
74LS42	1.75
74LS51	.65
74LS74	.75
74LS86	.75
74LS90	1.30
74LS93	1.00
74LS107	.95
74LS123	1.00
74LS151	.75
74LS153	1.20
74LS157	.85
74LS164	1.90
74LS367	.85
74LS368	.70

9000 SERIES

9301	.85
9309	.35
9322	.85
95H03	.55
9601	.75
9602	.50

MEMORY CLOCKS

74S188 (8223)	3.00
1702A	7.95
MM5314	3.00
MM5316	3.50
2102-1	1.75
2102L-1	1.95
TMS6011NC	6.95
8080AD	15.00
8T13	1.50
8T23	1.50
8T24	2.00
2107B-4	4.95

LINEARS, REGULATORS, etc.

8266	.35
8836	.95
MCT2	.95
8038	3.95
LM201	.75
LM301	.25
LM308 (Mini)	.75
LM309H	.65
LM309K (340K-5)	.85
LM310	1.15
LM311D (Mini)	.75
LM318 (Mini)	.65

LM320K5 (7905)	1.65
LM320K12	1.65
LM320T12	1.25
LM320T15	1.65
LM339	.95
7805 (340T-5)	.95
LM340T-12	1.00
LM340T-15	1.00
LM340T-18	1.00

LM340T-24	.95
LM340K-12	2.15
LM340K-15	1.25
LM340K-18	1.25
LM340K-24	.95
LM373	2.95
LM380	.95
LM709 (8,14 PIN)	.25
LM711	.45

LM723	.50
LM725	1.75
LM739	1.50
LM741 8-14	.20
LM747	1.10
LM1307	1.25
LM1458	.95
LM3900	.50
LM75451	.65
NE555	.50
NE556	.95
NE565	.95
NE566	1.75
NE567	1.35
SN72720	1.35
SN72820	1.35

INTEGRATED CIRCUITS UNLIMITED

7889 Clairemont Mesa Blvd. San Diego, CA 92111 (714) 278-4394

All orders shipped prepaid — No minimum

Open accounts invited — COD orders accepted

Discounts available at OEM Quantities

California Residents add 6% Sales Tax

24 Hour Phone (714) 278-4394 **MasterCharge / BankAmericard**

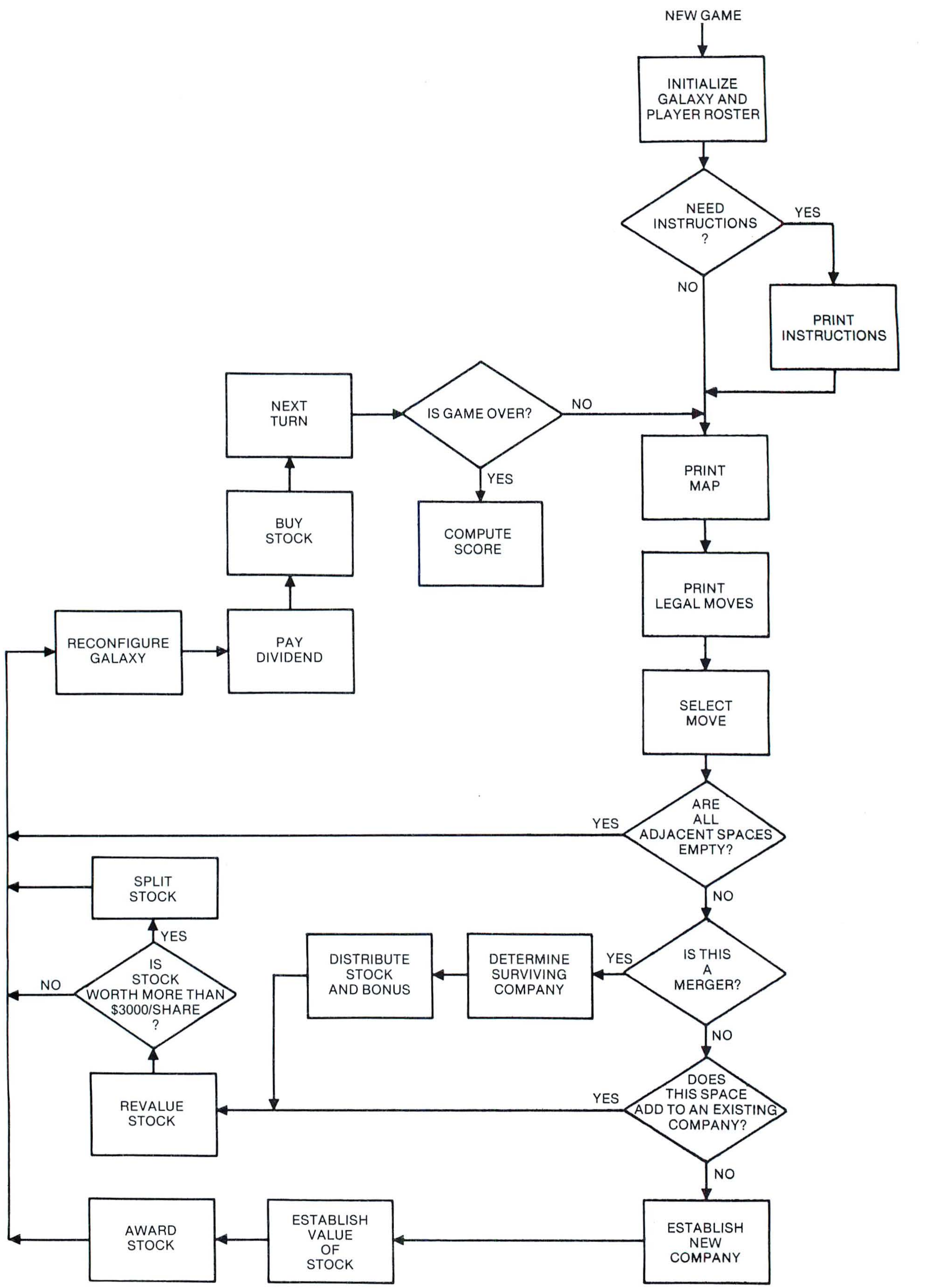


Figure 1. Flow Chart for "Star Lanes"

You only have $12356 — try again.
Buy how many shares of Denebola Shippers at $2475.
You now own 379 ? 4

MAP OF THE GALAXY

	A	B	C	D	E	F	G	H	I	J	K	L
1	D	D	D	D	●	●	●	●	●	●	●	●
2	●	●	●	D	D	D	D	●	●	D	D	D
3	●	●	●	D	D	●	D	D	D	D	D	*
4	+	●	D	D	D	D	D	●	●	●	D	●
5	●	●	D	D	●	*	D	●	●	●	D	●
6	●	D	D	D	●	A	●	●	●	D	D	●
7	●	●	D	D	●	●	●	●	B	*	●	●
8	●	●	D	●	●	●	●	B	B	B	B	B
9	●	●	●	●	●	●	●	●	●	●	B	B

Steve, here are your legal moves for this turn: **7 g** / 4 b / 1 g / 7 k / 2 a /
What is your move? 7 k

Special Announcement!!

Betelgeuse, Ltd, has just been merged into Denebola Shippers! Please note the following transactions.

Old Stock = Betelgeuse, Ltd.
New Stock = Denebola Shippers

Player	Old Stock	New Stock	Total Holdings	Bonus Paid
Steve	79	40	426	$9136
Debbie	68	34	417	$7863

Special Announcement!!

The Stock of Denebola Shippers has split 2 for 1!

Your current cash = $98945
Buy how many shares of Altair Starways at $600.
You now own 0 ? 0.
Your current cash = $98945
Buy how many shares of Denebola Shippers at $2087.
You now own 852 ? 45

MAP OF THE GALAXY

	A	B	C	D	E	F	G	H	I	J	K	L
1	D	D	D	D	●	●	●	●	●	●	●	●
2	●	●	●	D	D	D	D	●	●	D	D	D
3	●	●	●	D	D	●	D	D	D	D	D	*
4	+	●	D	D	D	D	D	●	●	●	D	●
5	●	●	D	D	●	*	D	●	●	●	D	●
6	●	D	D	D	●	A	●	●	●	D	D	●
7	●	●	D	D	●	●	●	●	D	*	D	●
8	●	●	D	●	●	●	●	D	D	D	D	D
9	●	●	●	●	●	●	●	●	●	●	D	D

Debbie, here are your legal moves for this turn: 5 e / 9 d / 2 h / 7 a / 2 b /
What is your move? 2 h
Your current cash = $102416
Buy how many shares of Altair Starways at $600.
You now own 30 ? 0
Your current cash = $102416
Buy how many shares of Denebola Shippers at $2187.
You now own 834 ? 46

Special Announcement!!

The game is over — here are the Final Standings

Player	Cash Value of Stock	Cash on Hand	Net Worth
Steve	$1.96174E+06	$5030	$1.96677E+06
Debbie	$1.94256E+06	$1814	$1.94437E+06

Another game? No.

EXPANDED FLOW CHART

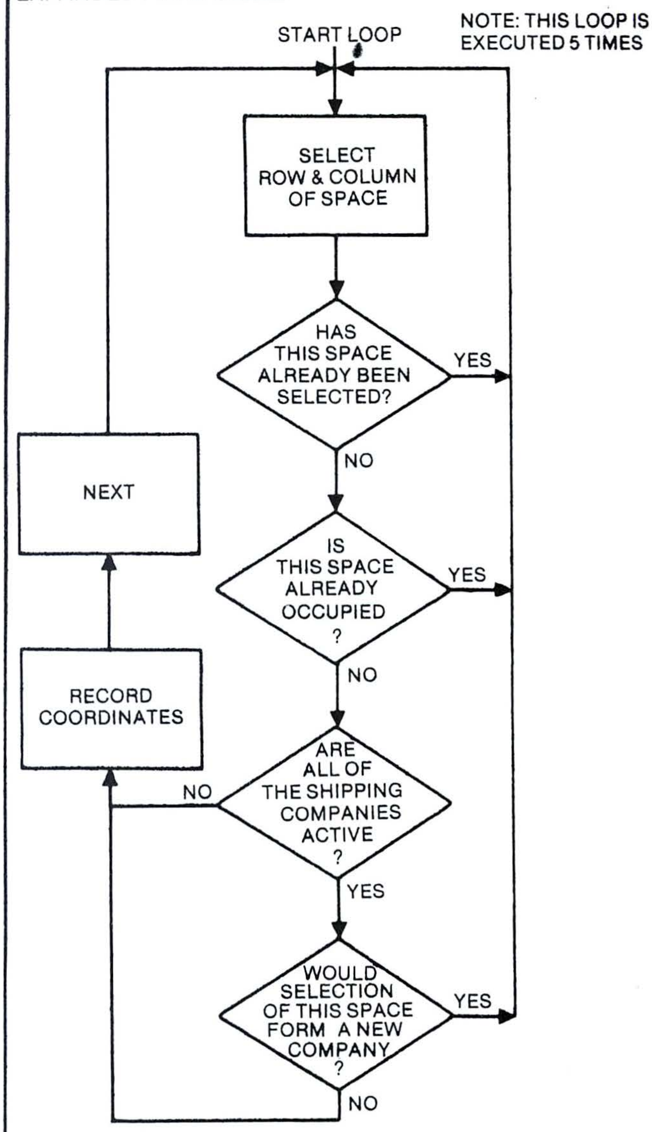


Figure 2. Loop for Selecting "Legal Moves" for Player

OK

STAR LANES PROGRAM BASIC LISTING

```
10 REM THE GAME OF STAR LANES - AN INTERSTELLAR COMMERCE GAME
20 REM FOR 2-4 PLAYERS - COPYRIGHT 1977 BY STEVEN FABER
30 REM WRITTEN IN ALTAIR BASIC 12/17/76
40 PRINTCHR$(12):PRINT:PRINT:PRINTTAB(10)"* S * T * A * R **";
50 PRINT" L * A * N * E * S *"
60 DIMM(10,13),S(5,4),N$(5),D1(5),S1(5),Q(5)
70 M$(5)="ERIDANI EXPEDITERS":FORI=1TO5:FORJ=1TO4:S(I,J)=0
75 D1(I)=0:S1(I)=100:Q(I)=0:B(I)=6000:NEXTJ,I
80 M$(3)="CAPELLA FREIGHT CO.":M$(4)="DENEBOLA SHIPPERS"
90 M$(1)="ALTAIR STARWAYS":M$(2)="BETELGEUSE, LTD."
100 L$=".+*ABCDE":M$="ABCDEFGHIJKL":FORI=1TO9:FORJ=1TO12
110 IFINT(RND(1)*20)+1<>10THENM(I,J)=1:GOTO130
120 M(I,J)=3
130 NEXTJ,I:INPUT"HOW MANY PLAYERS (2-4)";P1
140 INPUT"DOES ANY PLAYER NEED INSTRUCTIONS";R$
150 IFLEFT$(R$,1)="Y"THENGOSUB8000
160 FORI=1TOP1:PRINT"PLAYER";I;:INPUT"WHAT IS YOUR NAME";P$(I)
170 NEXTI:PRINT:PRINT"NOW I WILL DECIDED WHO GOES FIRST...":PRINT
180 I=INT(P1*RND(1)+1):PRINTP$(I);" IS THE FIRST PLAYER TO MOVE."
185 K=0
190 P=I:GOTO220
200 K=K+1:IFK=48THEN9500
210 P=P+1:IFP=P1+1THENP=1
220 FORI=1TO5
230 R(I)=INT(9*RND(1)+1):C(I)=INT(12*RND(1)+1)
240 FORI1=I-1TO0STEP-1:IFR(I)=R(I1)ANDC(I)=C(I1)THEN230
250 NEXTI1:IFM(R(I),C(I))>1THEN230
260 FORI1=1TO5:IFQ(I1)=0THEN340
270 NEXTI1:IFM(R(I),C(I)+1)>3ORM(R(I),C(I)-1)>3THEN340
```

```
280 IFM(R(I)+1,C(I))>3ORM(R(I)-1,C(I))>3THEN340
290 A1=M(R(I),C(I)+1):A2=M(R(I),C(I)-1)
300 A3=M(R(I)+1,C(I)):A4=M(R(I)-1,C(I))
310 IFA1=2ANDA2<4ANDA3<4ANDA4<4THEN230
315 IFA2=2ANDA1<4ANDA3<4ANDA4<4THEN230
320 IFA3=2ANDA1<4ANDA2<4ANDA4<4THEN230
325 IFA4=2ANDA1<4ANDA2<4ANDA3<4THEN230
330 IFA1=3ANDA2<4ANDA3<4ANDA4<4THEN230
332 IFA2=3ANDA1<4ANDA3<4ANDA4<4THEN230
335 IFA3=3ANDA1<4ANDA2<4ANDA4<4THEN230
337 IFA4=3ANDA1<4ANDA2<4ANDA3<4THEN230
340 NEXTI:GOSUB1000:PRINT:PRINTP$(P);
350 PRINT", HERE ARE YOUR LEGAL MOVES FOR THIS TURN:"
360 FORI=1TO5:PRINTR(I);MID$(M$,C(I),1);" /";:NEXTI:PRINT
370 INPUT"WHAT IS YOUR MOVE";R$:IFLEFT$(R$,1)="M"THENGOSUB1000:GOTO350
372 IFLEFT$(R$,1)="S"THENGOSUB1440:GOTO350
375 R=VAL(LEFT$(R$,1))
380 C=ASC(RIGHT$(R$,1))-64:FORI=1TO5:IFR=R(I)ANDC=C(I)THEN400
390 NEXTI:PRINT"THAT SPACE WAS NOT INCLUDED IN THE LIST...":GOTO370
400 A1=M(R-1,C):A2=M(R+1,C):A3=M(R,C+1):A4=M(R,C-1)
410 IFA1<=1ANDA2<=1ANDA3<=1ANDA4<=1THENM(R,C)=2:GOTO800
420 IFA1>3ANDA2>3ANDA2<>A1THENGOSUB1060
430 IFA1>3ANDA3>3ANDA3<>A1THENGOSUB1060
440 IFA1>3ANDA4>3ANDA4<>A1THENGOSUB1060
450 IFA2>3ANDA3>3ANDA3<>A2THENGOSUB1060
460 IFA2>3ANDA4>3ANDA4<>A2THENGOSUB1060
470 IFA3>3ANDA4>3ANDA4<>A3THENGOSUB1060
480 IFA1<4ANDA2<4ANDA3<4ANDA4<4THEN660
490 IFM(R,C)>3THEN800
500 IFA1>3THENI=A1-3
510 IFA2>3THENI=A2-3
520 IFA3>3THENI=A3-3
530 IFA4>3THENI=A4-3
540 Q(I)=Q(I)+1:S1(I)=S1(I)+100:M(R,C)=I+3:GOTO700
660 FORI=1TO5:IFQ(I)=0THEN680
670 NEXTI:IFM(R,C)<3THENM(R,C)=2:GOTO800
680 GOSUB7900:PRINT"A NEW SHIPPING COMPANY HAS BEEN FORMED!"
690 PRINT"IT'S NAME IS ";M$(I):S(I,P)=S(I,P)+5:Q(I)=1
695 PRINT:PRINT:PRINT:PRINT:PRINT
700 IFA1=3THENS1(I)=S1(I)+500
710 IFA2=3THENS1(I)=S1(I)+500
720 IFA3=3THENS1(I)=S1(I)+500
730 IFA4=3THENS1(I)=S1(I)+500
740 IFA1=2THENS1(I)=S1(I)+100:Q(I)=Q(I)+1:M(R-1,C)=I+3
750 IFA2=2THENS1(I)=S1(I)+100:Q(I)=Q(I)+1:M(R+1,C)=I+3
760 IFA3=2THENS1(I)=S1(I)+100:Q(I)=Q(I)+1:M(R,C+1)=I+3
770 IFA4=2THENS1(I)=S1(I)+100:Q(I)=Q(I)+1:M(R,C-1)=I+3
780 IFS1(I)>=3000THENT1=I:GOSUB1400
790 M(R,C)=I+3
800 FORI=1TO5:B(P)=B(P)+INT(.05*S(I,P)*S1(I)):NEXTI
810 FORI=1TO5:IFQ(I)=0THEN900
820 PRINT"YOUR CURRENT CASH= $";B(P)
830 PRINT"BUY HOW MANY SHARES OF ";M$(I);" AT $";S1(I):PRINTTAB(5);
840 PRINT"YOU NOW OWN";S(I,P);
850 INPUTR3$:IFLEFT$(R3$,1)="M"THENR3$="":GOSUB1000:GOTO830
855 IFLEFT$(R3$,1)="S"THENR3$="":GOSUB1440:GOTO830
856 R3=VAL(R3$):R3$=""
860 IFR3*S1(I)<=B(P)THEN880
870 PRINT"YOU ONLY HAVE $";B(P);"- TRY AGAIN":GOTO830
880 IFR3=0THEN900
890 S(I,P)=S(I,P)+R3:B(P)=B(P)-(R3*S1(I))
900 NEXTI:GOTO200
1000 PRINTCHR$(12):PRINTTAB(22)"MAP OF THE GALAXY"
1010 PRINTTAB(21)"*******************"
1020 PRINTTAB(12)" A  B  C  D  E  F  G  H  I  J  K  L"
1030 FORR2=1TO9:PRINTTAB(9)R2;:FORC2=1TO12:PRINT" ";
1040 PRINTMID$(L$,M(R2,C2),1);" ";:NEXTC2:PRINT:NEXTR2
1050 RETURN
1060 F1=A1-3:IFF1<0THENF1=0
1061 F2=A2-3:IFF2<0THENF2=0
1062 F3=A3-3:IFF3<0THENF3=0
1063 F4=A4-3:IFF4<0THENF4=0
1065 T=Q(F1):T1=F1:IFQ(F2)>Q(F1)THENT=Q(F2):T1=F2
1070 IFQ(F3)>TTHENT=Q(F3):T1=F3
1080 IFQ(F4)>TTHENT=Q(F4):T1=F4
1090 IFF1=T1ORA1<4THEN1110
1100 X=F1:GOSUB1180
1110 IFF2=T1ORA2<4THEN1130
1120 X=F2:GOSUB1180
1130 IFF3=T1ORA3<4THEN1150
1140 X=F3:GOSUB1180
1150 IFF4=T1ORA4<4THEN1170
1160 X=F4:GOSUB1180
1170 RETURN
1180 GOSUB7900:PRINTM$(X);" HAS JUST BEEN MERGED INTO ";
1190 PRINTM$(T1);"!":PRINT"PLEASE NOTE THE FOLLOWING TRANSACTIONS."
1200 PRINT:PRINTTAB(4)"OLD STOCK = ";M$(X);"      NEW STOCK = ";
1210 PRINTM$(T1):PRINT
1220 PRINT"PLAYER";TAB(10)"OLD STOCK";TAB(22)"NEW STOCK";TAB(34);
1230 PRINT"TOTAL HOLDINGS";TAB(53)"BONUS PAID"
1240 FORI=1TOP1:PRINTP$(I);TAB(10)S(X,I);TAB(22)INT((.5*S(X,I))+.5);
1250 PRINTTAB(34)S(T1,I)+INT((.5*S(X,I))+.5);
1260 X1=0:FORI1=1TOP1:X1=X1+S(X,I1):NEXTI1
1265 PRINTTAB(53);
1270 PRINT" $";INT(10*((S(X,I)/X1)*S1(X))):NEXTI
1290 FORI=1TOP1:S(T1,I)=S(T1,I)+INT((.5*S(X,I))+.5)
1300 B(I)=B(I)+INT(10*((S(X,I)/X1)*S1(X))):NEXTI
1310 FORI=1TO9:FORJ=1TO12:IFM(I,J)=X+3THENM(I,J)=T1+3
1315 NEXTJ,I
1317 A1=M(R-1,C):A2=M(R+1,C):A3=M(R,C+1):A4=M(R,C-1)
1318 F1=A1-3:IFF1<0THENF1=0
1319 F2=A2-3:IFF2<0THENF2=0
1320 Q(T1)=Q(T1)+Q(X):S1(T1)=S1(T1)+S1(X):IFS1(T1)>3000THENGOSUB1400
1321 F3=A3-3:IFF3<0THENF3=0
1322 F4=A4-3:IFF4<0THENF4=0
1340 S1(X)=100:Q(X)=0:FORI=1TOP1:S(X,I)=0:NEXTI
1355 PRINT:PRINT:PRINT:PRINT:PRINT
1360 M(R,C)=T1+3
1370 RETURN
1400 GOSUB7900:PRINT"THE STOCK OF ";
1410 PRINTM$(T1);" HAS SPLIT 2 FOR 1!":S1(T1)=INT(S1(T1)/2)
1415 PRINT:PRINT:PRINT:PRINT:PRINT
1420 FORI1=1TOP1:S(T1,I1)=2*S(T1,I1):NEXTI1
1430 RETURN
1440 PRINTCHR$(12):PRINT
1450 PRINT"STOCK";TAB(30)"PRICE PER SHARE";TAB(50)"YOUR HOLDINGS"
1460 FORI3=1TO5:IFS1(I3)=100THEN1480
1470 PRINTM$(I3);TAB(30)S1(I3);TAB(50)S(I3,P)
1480 NEXTI3:RETURN
7900 REM INSERT BELL (CNTRL G) HERE
7910 PRINTTAB(22)"SPECIAL ANNOUNCEMENT!!":PRINT
7920 RETURN
8000 PRINT:PRINT"   STAR LANES IS A GAME OF INTERSTELLAR TRADING."
8010 PRINT"THE OBJECT OF THE GAME IS TO AMASS THE GREATEST AMOUNT"
8020 PRINT"OF MONEY. THIS IS ACCOMPLISHED BY ESTABLISHING VAST,"
8030 PRINT"INTERSTELLAR SHIPPING LANES, AND PURCHASING STOCK IN"
8040 PRINT"THE COMPANIES THAT CONTROL THOSE TRADE ROUTES. DURING"
8050 PRINT"THE COURSE OF THE GAME, STOCK APPRECIATES IN VALUE AS"
8060 PRINT"THE SHIPPING COMPANIES BECOME LARGER. ALSO, SMALLER"
8070 PRINT"COMPANIES CAN BE MERGED INTO LARGER ONES, AND STOCK"
8080 PRINT"IN THE SMALLER FIRM IS CONVERTED INTO STOCK IN THE "
8090 PRINT"LARGER ONE AS DESCRIBED BELOW.":PRINT
8100 PRINT"   EACH TURN, THE COMPUTER WILL PRESENT THE PLAYER WITH"
8120 PRINT"FIVE PROSPECTIVE SPACES TO OCCUPY ON A 9X12 MATRIX"
8130 PRINT"(ROWS 1-9, COLUMNS A-L). THE PLAYER, AFTER EXAMINING"
8140 PRINT"THE MAP OF THE GALAXY TO DECIDE WHICH SPACE HE WISHES"
8150 PRINT"TO OCCUPY, RESPONDS WITH THE ROW AND COLUMN OF THAT"
8160 PRINT"SPACE, I.E., 7E, 8A, ETC. THERE ARE FOUR POSSIBLE"
8170 PRINT"MOVES A PLAYER CAN MAKE.":PRINT
8180 PRINT"   1. HE CAN ESTABLISH AN UNATTACHED OUTPOST- IF HE"
8190 PRINT"SELECTS A SPACE THAT IS NOT ADJACENT TO A STAR, ANOTHER"
8200 PRINT"UNATTACHED OUTPOST, OR AN EXISTING SHIPPING LANE, THIS"
8210 PRINT"SPACE WILL BE DESIGNATED WITH A '+'. HE WILL THEN PROCEED"
8230 PRINT"WITH STOCK TRANSACTIONS, AS LISTED BELOW.":PRINT
8240 PRINT"   2. HE CAN ADD TO AN EXISTING LANE- IF HE SELECTS A SPACE"
8250 PRINT"WHICH IS ADJACENT TO ONE - AND ONLY ONE EXISTING SHIPPING"
8260 PRINT"LANE, THE SPACE HE SELECTS WILL BE ADDED TO THAT SHIPPING"
8270 PRINT"LANE, AND WILL BE DESIGNATED WITH THE FIRST LETTER OF "
8280 PRINT"THE COMPANY THAT OWNS THAT LANE. IF THERE ARE ANY STARS"
8290 PRINT"OR UNATTACHED OUTPOSTS ALSO ADJACENT TO THE SELECTED SPACE,"
8300 PRINT"THEY, TOO, WILL BE INCORPORATED INTO THE EXISTING LANE."
8310 PRINT"EACH NEW SQUARE ADJACENT TO A STAR ADDS $500 PER SHARE, AND"
8320 PRINT"EACH NEW OUTPOST ADDS $100 PER SHARE TO THE MARKET VALUE"
8330 PRINT"OF THE STOCK OF THAT SHIPPING COMPANY.":PRINT
8340 PRINT"   3. HE MAY ESTABLISH A NEW SHIPPING LANE- IF THERE"
8350 PRINT"ARE FIVE OR LESS EXISTING SHIPPING LANES ESTABLISHED,"
8360 PRINT"THE PLAYER MAY, GIVEN THE PROPER SPACE TO PLAY, ESTABLISH"
8370 PRINT"A NEW SHIPPING LANE. HE MAY DO THIS BY OCCUPYING A SPACE"
8380 PRINT"ADJACENT TO A STAR OR ANOTHER UNATTACHED OUTPOST, BUT "
8390 PRINT"NOT ADJACENT TO AN EXISTING SHIPPING LANE. IF HE "
8400 PRINT"ESTABLISHES A NEW SHIPPING LANE, HE IS AUTOMATICALLY"
8410 PRINT"ISSUED 5 SHARES IN THE NEW COMPANY AS A REWARD. HE"
8420 PRINT"MAY THEN PROCEED TO BUY STOCK IN THAT COMPANY, OR ANY"
8430 PRINT"OTHER ACTIVE COMPANY, AS DESCRIBED BELOW. THE MARKET "
8440 PRINT"VALUE OF THE NEW STOCK IS ESTABLISHED BY THE NUMBER OF"
8450 PRINT"STARS AND OCCUPIED SPACES AS DESCRIBED IN #2 ABOVE.":PRINT
8460 PRINT"   4. HE MAY MERGE TWO EXISTING COMPANIES- IF PLAYER"
8470 PRINT"SELECTS A SPACE ADJACENT TO TWO EXISTING SHIPPING"
8480 PRINT"LANES, A MERGER OCCURS. THE LARGER COMPANY TAKES OVER"
8490 PRINT"THE SMALLER COMPANY, THE STOCK OF THE LARGER COMPANY IS"
8500 PRINT"INCREASED IN VALUE ACCORDING TO THE NUMBER OF SPACES AND"
8510 PRINT"STARS ADDED TO ITS LANE, EACH PLAYER'S STOCK IN THE"
8520 PRINT"SMALLER COMPANY IS EXCHANGED FOR SHARES IN THE LARGER"
8530 PRINT"ON A RATIO OF 2 SHARES OF THE SMALLER = 1 SHARE OF THE"
8540 PRINT"LARGER. ALSO, EACH PLAYER IS PAID A CASH BONUS PROPORTIONAL"
8550 PRINT"TO THE PERCENTAGE OF OUTSTANDING STOCK HE HELD IN THE"
8560 PRINT"SMALLER COMPANY. NOTE: AFTER A COMPANY BECOMES DEFUNCT"
8570 PRINT"THROUGH THIS MERGER PROCESS, IT CAN REAPPEAR ELSEWHERE"
8580 PRINT"ON THE BOARD IF A NEW COMPANY IS ESTABLISHED (SEE #3 ABOVE)"
8590 PRINT:PRINT"   NEXT THE COMPUTER ADDS STOCK DIVIDENDS TO THE"
8600 PRINT"PLAYER'S CASH ON HAND (5% OF THE MARKET VALUE OF THE "
8610 PRINT"STOCK IN HIS POSSESSION), AND OFFERS HIM THE OPPORTUNITY TO"
8620 PRINT"PURCHASE STOCK IN ANY OF THE ACTIVE COMPANIES ON THE"
8630 PRINT"BOARD. STOCK MAY NOT BE SOLD, BUT THE MARKET VALUE OF"
8640 PRINT"EACH PLAYER'S STOCK IS TAKEN INTO ACCOUNT AT THE END"
8650 PRINT"OF THE GAME TO DETERMINE THE WINNER. IF THE MARKET VALUE"
8660 PRINT"OF A GIVEN STOCK EXCEEDS $3000 AT ANY TIME DURING THE "
8670 PRINT"GAME, THAT STOCK SPLITS TWO FOR ONE. THE PRICE IS CUT"
8680 PRINT"IN HALF, AND THE NUMBER OF SHARES OWNED BY EACH PLAYER"
8690 PRINT"IS DOUBLED.":PRINT
8700 PRINT"NOTE: THE PLAYER MAY LOOK AT HIS PORTFOLIO AT ANY TIME"
8710 PRINT"DURING THE COURSE OF HIS TURN BY RESPONDING WITH 'STOCK'"
8720 PRINT"TO AN INPUT STATEMENT. LIKEWISE, HE CAN REVIEW THE MAP"
8730 PRINT"OF THE GALAXY BY TYPING 'MAP' TO AN INPUT STATEMENT."
8740 PRINT:PRINT"GAME ENDS AFTER 48 MOVES. PLAYER WITH THE GREATEST"
8750 PRINT"NET WORTH AT THAT POINT IS THE WINNER.":PRINT:PRINT
8760 RETURN
9500 GOSUB7900:PRINT"THE GAME IS OVER - HERE ARE THE FINAL STANDINGS"
9505 PRINT
9510 PRINT"PLAYER";TAB(10)"CASH VALUE OF STOCK";TAB(33)"CASH ON HAND";
9520 PRINTTAB(50)"NET WORTH":PRINT
9530 FORI=1TOP1:FORJ=1TO5:D1(I)=D1(I)+(S1(J)*S(J,I)):NEXTJ,I
9540 FORI=1TOP1:PRINTP$(I);TAB(10)"$";D1(I);TAB(33)"$";B(I);
9550 PRINTTAB(50)"$";D1(I)+B(I):NEXTI
9560 INPUT"ANOTHER GAME";R$:IFLEFT$(R$,1)="Y"THEN70
```

DIGI-KEY CORPORATION
Quality Electronic Components

DON'T FORGET OUR DISCOUNTS WHEN COMPARING PRICES

PRICE BREAKTHROUGH ON 74LS'

74LS00	.28	74LS30	.28	74LS90	.57	74LS157	.75	74LS248	.79
74LS01	.28	74LS32	.33	74LS92	.57	74LS158	.75	74LS249	.79
74LS02	.28	74LS37	.33	74LS93	.57	74LS160	1.02	74LS253	.84
74LS03	.28	74LS38	.33	74LS107	.39	74LS161	1.02	74LS257	.75
74LS04	.29	74LS40	.28	74LS109	.39	74LS162	1.02	74LS258	.75
74LS05	.29	74LS42	.67	74LS112	.39	74LS163	1.02	74LS266	.39
74LS08	.29	74LS47	.79	74LS113	.39	74LS164	1.02	74LS283	.79
74LS09	.29	74LS48	.77	74LS114	.39	74LS168	1.14	74LS290	.65
74LS10	.28	74LS51	.28	74LS125	.49	74LS169	1.14	74LS293	.65
74LS11	.28	74LS54	.28	74LS126	.49	74LS170	1.73	74LS365	.67
74LS12	.28	75LS55	.28	74LS132	.81	74LS173	1.34	74LS366	.67
74LS13	.47	74LS73	.39	74LS136	.39	74LS174	1.06	74LS367	.67
74LS14	1.02	74LS74	.39	74LS138	.73	74LS175	.84	74LS368	.67
74LS15	.28	74LS75	.53	74LS139	.73	74LS190	1.18	74LS386	.39
74LS20	.28	74LS76	.39	74LS151	.75	74LS191	1.18	74LS670	2.34
74LS21	.28	74LS78	.39	74LS153	.75	74LS196	.86	71LS95	.77
74LS22	.28	74LS83	.79	74LS154	1.10	74LS197	.86	71LS96	.77
74LS26	.33	74LS86	.39	74LS155	.75	74LS247	.79	71LS97	.77
74LS27	.33			74LS156	.75			71LS98	.77

INTEGRATED CIRCUITS — TTL, CMOS, LINEAR & MOS

7400	.21	7476	.32	74181	2.15	4012	.23	4520	1.14
7401	.21	7480	.70	74182	.79	4013	.40	4527	1.68
7402	.21	7482	.70	74184	2.19	4014	.96	4528	.88
7403	.21	7483	.70	74185	2.19	4015	.96	4585	1.23
7404	.21	7485	.89	74188	3.50	4016	.40	2102-1	1.99
7405	.21	7486	.28	74189	3.50	4017	1.05	8080A	24.95
7406	.25	7489	2.19	74190	1.23	4018	1.05	CA3046	.75
7407	.25	7490	.44	74191	1.23	4019	.23	LM2111N	1.25
7408	.21	7491	.70	74192	.88	4020	1.14	LM309K	1.80
7409	.21	7492	.44	74193	.88	4021	1.14	LM324A	1.28
7410	.21	7493	.44	74194	.88	4022	.96	LM340T-5	1.25
7411	.21	7494	.70	74195	.88	4023	.23	LM340T-6	1.25
7412	.21	7495	.70	74196	.88	4024	.84	LM340T-8	1.25
7413	.25	7496	.70	74197	.88	4025	.23	LM340T-12	1.25
7414	.89	74100	1.28	74198	1.49	4026	1.68	LM340T-15	1.25
7416	.25	74107	.30	74199	1.49	4027	.40	LM340T-18	1.25
7417	.25	74109	.33	74251	1.09	4028	.89	LM340T-24	1.25
7420	.21	74121	.35	74279	.55	4029	1.14	LM3900N	.88
7421	.25	74122	.44	74365	.67	4030	.23	LM3909N	.69
7423	.35	74123	.61	74366	.67	4033	1.51	MC1456V	1.00
7425	.35	74125	.40	74367	.67	4034	3.50	MC1458V	.53
7426	.25	74126	.40	74368	.67	4035	1.14	MC3302P	1.15
7427	.33	74132	.70	8093	.40	4040	1.14	NE536T	3.24
7428	.28	74141	.88	8094	.40	4041	.79	NE540L	2.04
7430	.21	74145	.70	9095	.67	4042	.79	NE555V	.48
7432	.25	74147	1.63	8096	.67	4043	.70	NE556A	.88
7433	.30	74148	1.30	8097	.67	4044	.70	NE560B	3.83
7437	.25	74150	1.16	8098	.67	4046	1.86	NE561B	3.83
7438	.25	74151	.70	75150	1.16	4049	.40	NE562B	3.83
7440	.21	74153	.65	75450	.88	4050	.40	NE565A	1.25
7442	.53	74154	1.03	75451	.61	4051	1.26	NE566V	1.28
7443	.63	74155	.70	75452	.61	4052	1.26	NE567V	1.36
7445	.70	74156	.70	75453	.61	4053	1.26	uA709CV	.44
7446	.70	74157	.70	75454	.61	4060	1.58	uA710CA	.44
7447	.70	74160	.88	75491	.81	4066	.79	uA711CA	.53
7448	.70	74161	.88	75492	.84	4071	.23	uA723CA	.60
7450	.21	74162	.88	75493	1.09	4072	.23	uA733CA	.75
7451	.21	74163	.88	75494	1.19	4073	.23	uA741CV	.44
7453	.21	74164	.96	82S25	2.19	4075	.23	uA747CA	.70
7454	.21	74165	1.15	4000	.23	4081	.23	uA748CV	.49
7459	.21	74166	1.26	4001	.23	4082	.23	uA7805CU	1.25
7460	.21	74170	2.64	4002	.23	4502	.79	uA7806CU	1.25
7470	.30	74173	1.42	4006	1.23	4510	1.14	uA7808CU	1.25
7472	.30	74174	.98	4007	.23	4511	1.05	uA7812CU	1.25
7473	.30	74175	.93	4008	.79	4514	2.80	uA7815CU	1.25
7474	.30	74176	.79	4009	.44	4515	2.80	uA7818CU	1.25
7475	.49	74177	.79	4010	.44	4516	1.23	uA7824CU	1.25
		74180	.70	4011	.23	4518	1.14		

NEW

HOBBY-WRAP Model BW-630

Battery **wire wrapping** tool

ONLY $34.95 (batteries not included)

COMPLETE WITH BIT AND SLEEVE

WIRE WRAPPING WIRE IN BULK

Red or Black 30 ga. Kynar

100' $2.00 — 500' $8.50 — 1000' $15.00

SILICON DIODES

1N4001	.64/10	5.50/C	$49/M
1N4002	.66/10	5.60/C	$51/M
1N4003	.68/10	5.80/C	$52/M
1N4004	.70/10	5.95/C	$54/M
1N4005	.82/10	7.05/C	$63/M
1N4006	.90/10	7.75/C	$69/M
1N4007	.99/10	8.60/C	$77/M
1N4148	.40/10	3.50/C	$29/M

Double Digit Discounts Save You Even More!

½ WATT ZENER DIODES

1N5226B	3.3v	15	$11/C	1N5236B	7.5v	.15	$11/C
1N5227B	3.6v	.15	$11/C	1N5237B	8.2v	.15	$11/C
1N5228B	3.9v	.15	$11/C	1N5238B	8.7v	.15	$11/C
1N5229B	4.3v	.15	$11/C	1N5239B	9.1v	.15	$11/C
1N5230B	4.7v	.15	$11/C	1N5240B	10v	.15	$11/C
1N5231B	5.1v	.15	$11/C	1N5241B	11v	.15	$11/C
1N5232B	5.6v	.15	$11/C	1N5242B	12v	.15	$11/C
1N5233B	6.0v	.15	$11/C	1N5243B	13v	.15	$11/C
1N5234B	6.2v	.15	$11/C	1N5244B	14v	.15	$11/C
1N5235V	6.8v	.15	$11/C	1N5245B	15v	.15	$11/C

BUY A-P PRODUCTS & BISHOP GRAPHICS FROM DIGI-KEY

SIGNETICS ANALOG MANUAL . . . $5.95

PLESSEY SAMPLER

An Assortment of Metalized Polyester Capacitors

300 Caps 18 Values $26.00

LED LAMPS

NSL5053 T-1¾. 18 $15/C

NSL5056 T-1¾. 18 $15/C

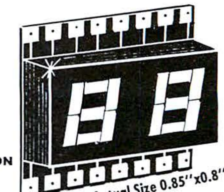
LED DUAL DIGITS

NEW!

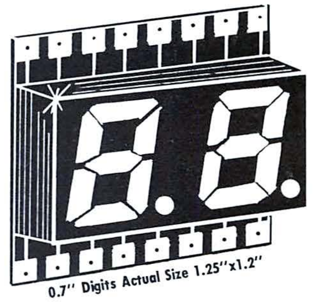
PRICED PER PAIR OF 2 DIGITS

NSN373 0.3" CC . $2.20/Pair
NSN374 0.3" CA . $2.20/Pair
NSN584 0.5" CC . $2.60/Pair
NSN584 0.5" CA . $2.60/Pair
NSN783 0.7" CC . $3.00/Pair
NSN784 0.7" CA . $3.00/Pair

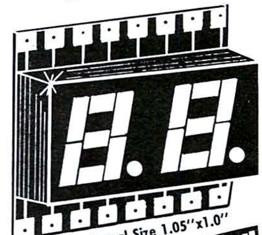
ALL LEADS BROUGHT OUT FOR EASE OF APPLICATION



0.3" Digits Actual Size 0.85"x0.8"



0.7" Digits Actual Size 1.25"x1.2"



0.5" Digits Actual Size 1.05"x1.0"

NEW!

MA1003 CAR CLOCK

12 Hour Only
12 Volt DC
Crystal Time Base
Bright Green Digits
Assembled and Tested

NEW!

NEW — FOR CAR OR BOAT!

The MA1003 bright green flourescent display offers a brilliance that cannot be achieved by LED displays, a feature that sold Detroit!

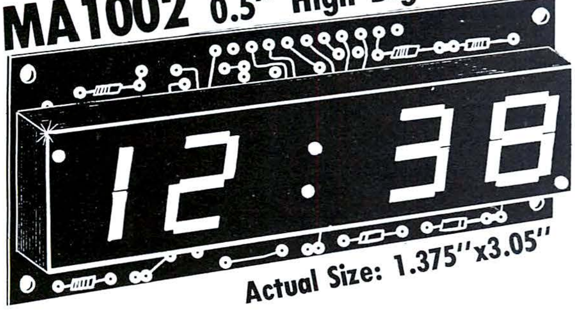
0.3" Digits Actual Size 1.75"x3.05"

MA1003 . . . . . $24.95

Includes 3 Push Button Switches

NEW!

MA1002 0.5" High Digits



Actual Size: 1.375"x3.05"

MA1002A 12 Hour AM-PM **$10.50**
MA1002C 24 Hour. **$10.50**
SPECIAL TRANSFORMER & SWITCHES $3.45

ABOUT OUR CLOCKS

The MA1002 and MA1010 series clock modules by National Semiconductor are fully assembled and tested clocks using a 4 digit LED display and an MOS integrated circuit on the same board. Simply connect switches and our special transformer and you have a fully functioning clock.

The MA1003 clock module is a fully assembled and tested 12 hour clock using a high brilliance green flourescent display and crystal time base making it perfect for car, boat or other portable use. It operates directly from 12 volts DC so no transformer is needed. Our price includes three push button switches for setting the time.

MA1002A .5" LED 12 Hour AM-PM Clock Module **$10.50**
MA1002A SET Module with Transformer & Switches . **$13.95**
MA1002C .5" LED 24 Hour Clock Module. **$10.50**
MA1002C SET Module with Transformer & Switches . **$13.95**
MA1003 12 Volt Car Clock with Switches **$24.95**
MA1010A .84" LED 12 Hour AM-PM Clock Module . . . **$13.00**
MA1010A SET Module with Transformer & Switches . **$16.45**
MA1010C .84" LED 24 Hour Clock Module **$13.00**
MA1010C SET Module with Transformer & Switches . **$16.45**

RADIAL ELECTROLYTICS

.47/50V	.08	.65/10	22/50V	12	1.00/10	330/25V	23	1.86/10
1/50V	.08	.65/10	100/6.3V	.09	.75/10	470/10R	21	1.71/10
2.2/50V	.08	.65/10	100/10V	10	.77/10	470/16V	23	1.81/10
3.3/50V	.08	.65/10	100/16V	.11	.85/10	470/25V	29	2.35/10
4.7/35V	.08	.65/10	100/25V	13	1.10/10	1000/10V	24	1.96/10
4.7/50V	.08	.68/10	100/50V	21	1.71/10	1000/16V	29	2.35/10
10/16V	.08	.65/10	220/10V	13	1.08/10	1000/25V	42	3.33/10
10/25V	.08	.65/10	220/16V	.15	1.16/10	2200/10V	42	3.33/10
10/50V	.10	.75/10	220/25V	21	1.71/10	2200/16V	54	4.30/10
22/16V	.08	.67/10	220/50V	29	2.35/10	2200/25V	58	4.67/10
22/25V	.09	.70/10	330/10V	15	1.16/10	3300/16V	89	7.14/10
			330/16V	21	1.66/10			

AXIAL ELECTROLYTICS

.47/10V	11	.90/10	33/25V	14	1.15/10	330/16V	29	2.35/10
1/30V	11	.90/10	33/50V	19	1.52/10	330/25V	32	2.54/10
3.3/35V	12	.95/10	47/16V	14	1.15/10	470/16V	32	2.55/10
3.3/50V	12	1.00/10	47/25V	17	1.30/10	470/25V	37	3.00/10
4.7/25V	11	.90/10	47/50V	21	1.17/10	1000/10V	33	2.65/10
4.7/35V	12	.95/10	100/10V	14	1.13/10	1000/16V	39	3.15/10
4.7/50V	12	1.00/10	100/16V	17	1.30/10	1000/25V	56	4.50/10
10/25V	12	1.00/10	100/25V	20	1.55/10	2200/10V	50	3.96/10
10/50V	14	1.15/10	100/50V	29	2.30/10	2200/16V	62	4.95/10
22/16V	12	1.00/10	220/10V	18	1.42/10	2200/25V	79	6.36/10
22/25V	13	1.05/10	220/16V	20	1.55/10	3300/16V	95	7.63/10
22/50V	17	1.32/10	220/25V	29	2.35/10	4700/16V	1.09	8.70/10
33/16V	12	1.00/10	220/50V	40	3.23/10	10000/10V	1.15	9.19/10
			330/10V	14	1.16/10			

Double Digit Discounts Save You Even More!

MA1010 0.84" High Digits

Actual size: 1.75"x3.75"

MA1010A 12 Hour AM-PM **$13.00**
MA1010C 24 Hour. **$13.00**
SPECIAL TRANSFORMER & SWITCHES $3.45

SEND FOR OUR FREE CATALOG

WE STOCK A WIDE VARIETY OF PARTS NOT IN THIS AD PLUS MANY SPECIALLY PRICED BARGAINS!

DATA BOOKS

TTL IC's 595 p.	$4.00
Linear IC's 957 p	$5.00
CMOS 74C 256 p	$3.00
Memory IC's 592 p	$3.00
Interface IC's 464 p	$4.00
Volt. Regs. 128 p.	$3.00
Linear Appl. 1 432 p.	$4.00
Linear Appl. 2 246 p.	$3.00
Audio 196 p	$3.00
MOS/L51 IC's 713 p	$4.00
CMOS 4000 278 p	$3.25
Analog Manual 637 p	$5.95

SLIDE SWITCHES

SPST.	.15	1.20/10	10.00/C
SPDT	.19	1.70/10	13.00/C
DPDT	.23	2.00/10	19.00/C

STRANDED HOOK UP WIRE

20 ga PVC. .	2.50/100'	10.00/500'
22 ga PVC. .	2.80/100'	11.25/500'
24 ga PVC. .	2.10/100'	8.50/500'
26 ga PVC. .	2.10/100'	8.50/500'

50 VOLT DISCS

100 pf.	.40/10	3.50/C
220 pf.	.40/10	3.50/C
470 pf.	.40/10	3.50/C
.001 uf	.40/10	3.50/C
.0022 uf	.40/10	3.50/C
.0047 uf	.40/10	3.50/C
.01 uf	.45/10	3.65/C
.022 uf	.50/10	4.00/C
.047 uf	.70/10	5.60/C
.1 uf	1.35/10	11.50/C

WIRE-WRAPPING TOOL

$5.95

Wraps, Unwraps & Strips 30 ga. Wire

¼ & ½ WATT 5% CARBON FILM RESISTORS

5c each in multiples of 5 per value
$1.70/100 & $12.00/1000 of same value

1 ohm thru 1.0 megohm

I.C. SOCKETS

8 Pin Solder	.17	1.60/10
14 Pin Solder	.20	1.90/10
16 Pin Solder	.22	2.10/10
18 Pin Solder	.29	2.75/10
24 Pin Solder	.38	3.60/10
28 Pin Solder	.45	4.25/10
40 Pin Solder	.63	6.00/10
8 Pin W-W	.24	2.30/10
14 Pin W-W	.26	2.50/10
16 Pin W-W	.30	2.85/10
18 Pin W-W	.60	5.70/10
24 Pin W-W	.96	9.10/10
28 Pin W-W	1.12	10.00/10
40 Pin W-W	.92	8.75/10

HARDWARE

2-56 1/4 Screw	.99/C	7.20/M
2-56 1/2 Screw	.99/C	7.65/M
4-40 1/4 Screw	.55/C	3.60/M
4-40 1/2 Screw	.60/C	4.05/M
6-32 1/4 Screw	.65/C	4.40/M
6-32 1/2 Screw	.75/C	4.85/M
8-32 3/8 Screw	.90/C	5.85/M
8-32 5/8 Screw	.99/C	7.00/M
2-56 Hex Nut	.55/C	3.60/M
4-40 Hex Nut	.55/C	3.75/M
6-32 Hex Nut	.60/C	4.00/M
8-32 Hex Nut	.60/C	4.15/M
No. 2 Lockwasher	.85/C	5.75/M
No. 4 Lockwasher	.45/C	3.00/M
No. 6 Lockwasher	.45/C	3.00/M
No. 8 Lockwasher	.45/C	3.00/M

DOUBLE-DIGIT DISCOUNT SCHEDULE

Merchandise	Discount	Merchandise	Discount
$ 0.00-$24.99	NET	$100.00-$499.99	Less 15%
		$500.00-$999.99	Less 20%
$25.99-$99.99	Less 10%	$1000.00 & Up	Less 25%

Then Add the Standard Charge Below

STANDARD SHIPPING/HANDLING CHARGE

If your merchandise total after discount is between

$ 0.00-$ 4.99 . . add $2.00 — $ 50.00-$99.99 . add $0.25
$ 5.00-$24.99 . . add $0.75 — $100.00 & up . . No Charge
$25.00-$49.99 . . add $0.50

Includes shipping and insurance to USA & Canada

COD ORDERS ACCEPTED FOR SAME DAY SHIPMENT — CALL 218-681-6674

Send for free catalog or mail reader's service card

"Only Quality Components Sold!"

DON'T FORGET TO APPLY DISCOUNT SCHEDULE

DIGI-KEY CORPORATION
Box 677, Thief River Falls, MN 56701 — 218-681-6674

INTERFACE AGE™

MICROCOMPUTING FOR HOME AND THE SMALL BUSINESSMAN

The professional publication bringing microcomputing technology to the hobbyist, small businessman, educator, engineer and student. Every issue edited to bring technology and people together in the simplest manner.

INTERFACE AGE is packed with

- **HARDWARE ARTICLES** — Product profiles, comparisons, applications, modifications and construction projects.
- **SOFTWARE ARTICLES** — Microcomputer development software, short software routines, application software, off-line software storage formats, software communication standards and access to the microcomputer software depository for all **INTERFACE AGE** readers.
- **TUTORIALS** — Fundamentals of micro processors, basics for microcomputing, professional to technical transition information, understanding software, elementary math for computing.
- **NEW PRODUCTS** — Manufacturer profiles and latest product releases.
- **USER COMMUNICATION** — ***UPDATE*** — devoted to club and organization announcements and activities. — ***LETTERS TO THE EDITOR*** — Reader forum for expression of opinions and feedback on articles and features.
- **MICRO-MARKET/FIFO FLEA MARKET** — Low cost/no cost advertising for the new marketeer/garage sale enthusiast.

If you need to know how to get started in microcomputing or need the valuable software once your system is completed then **INTERFACE AGE** is a must for you.

Don't Delay — Subscribe Today!

MAKE CHECK PAYABLE TO: **INTERFACE AGE** MAGAZINE

P.O. Box 1234
Cerritos, CA 90701

12 Monthly Issues:
$10 U.S., $12 Can./Mex.
$18 International

Name ____________________

Address ____________________

City ____________ State______ Country________ Zip_____

Date____________ Signature ____________

☐ CHECK ☐ MONEY ORDER ☐ YOUR BANKAMERICARD ☐ master charge

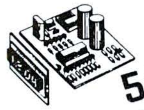
Account # ____________ Expires ____________

S. D. SALES CO.

P.O. BOX 28810 - E
DALLAS, TEXAS 75228

JUMBO LED CAR CLOCK

$16.95 KIT



50,000 Satisfied Clock Kit Customers Can't Be Wrong!

ALARM OPTION – $1.50
AC XFMR – $1.50

The Hottest Selling Kit We Ever Produced!

You requested it! Our first D.C. operated clock kit. Professionally engineered from scratch. Not a makeshift kluge as sold by others.
Features:
A. Bowmar Jumbo .5 inch LED array.
B. MOSTEK – 50250 – Super Clock Chip
C. On board precision crystal time base.
D. 12 or 24 hour Real Time Format.
E. Perfect for cars, boats, vans, etc.
F. P.C. Board and all parts (less case) included.

Specials!

3.579545 MHZ Time Base Crystal $1.25

39 MFD 16V Mallory Electrolytic 15 for $1.

28 PIN IC Sockets 3/$1.00

11,000 MFD 50WVDC Computer Grade Cap - $3.

60HZ Crystal Time Base

$5.95 2/$10.

FEATURES:
A. 60HZ output with accuracy comparable to a digital watch.
B. Directly interfaces with all MOS clock chips.
C. Super low power consumption (1.5MA typ.)
D. Uses latest MOS 17 stage divider IC.
E. Elimiates forever the problem of AC line glitches.
F. Perfect for cars, boats, campers, or even for portable clocks at ham field days.
G. Small size; can be used in existing enclosures.
Kit includes Crystal, Driver IC, PC board, plus all necessary parts and specs. At last count – over 20,000 sold!

S.D. Sales Exclusive!

1702A 2K EPROM

We tell it like it is! We could have said these were factory new, but here is the straight scoop. We bought a load of new computer gear that contained a quantity of 1701 A's in sockets. We carefully removed the parts, verified their quality, and are offering them on one heck of a deal. First come, first served. Satisfaction Guaranteed! U. V. Erasea-ble. (2.3 US access time.) NEW PRICE!

$2.95 each

UP YOUR COMPUTER!

21L02-1 1K LOW POWER 500 NS STATIC RAM

Time is of the essence!

And so is power. Not only are our RAM's faster than a speeding bullet but they are now very low power. We are pleased to offer prime new 21L02 -1 low power and super fast RAM's. Allows you to STRETCH your power supply farther and at the same time keep the wait light off!

8 for $12.95

$12.95 *S. D. Sales Exclusive!* $12.95

MOS 6 DIGIT UP–DOWN COUNTER

40 PIN DIP. Everything you ever wanted in a counter chip. Features: Direct LED segment drive, single power supply (12 VDC TYPE), six decades up/down, pre-loadable counter, separate pre-loadable compare register with compare output, BCD and seven segment outputs, internal scan oscillator, CMOS compatible, leading zero blanking, 1MHZ. count input frequency. Very limited quantity!

IC's from XEROX

7400 – 9c	7430 – 9c	7493 – 26c	1402A–Shift Regulator–50c
7402 – 9c	7440 – 9c	74121 – 22c	MH0025CN – 55c
7404 – 9c	7437 – 10c	74123 – 32c	
7406 – 11c	7438 – 10c	74151 – 22c	
7407 – 11c	7451 – 9c	74155 – 22c	
7410 – 9c	7474 – 16c	74193 – 35c	
7416 – 13c	7475 – 24c	8233 – 35c	
7420 – 9c	7486 – 16c	Intel – 1302 – 45c	

IC'S REMOVED FROM PC BOARDS ALL TESTED: FULL SPEC.

1000 MFD Filter Caps
Rated 35 WVDC Upright style with PC leads. Most popular value for hobbyists. Compare at up to $1.19 ea. from franchise type electronic parts stores.
4/$1.00

SLIDE SWITCH Assortment
Our best seller. Includes miniature and standard sizes; single and multi-position units. All new, first name brand. Try one package and you'll reorder more! Special!
12/$1.00

POWER RESISTOR 15 OHM 25W BY CLAROSTAT
75¢ ea.

RESISTOR ASSORTMENT
¼W 5% & 10%. PC leads. A good mix of values.
200/$2.

P.C. LEAD DIODES
1N4148/1N914 100/$2.00
1N4002 - 1A 100 PIV
40/$1.

Transistor Grab Bag no. 1
Just received a good, mixed lot of National TO92 plastic transistors. PNP & NPN, even a few FET's. 40 to 50% Yield. Untested. Asst.
500/$3.

DISC CAP ASSORTMENT
PC leads. At least 10 different values. Includes: .001, .01, .05 plus other standard values.
60/$1.00

SIX DIGIT ALARM CLOCK KIT

$9.95 KIT

P.C. Board – $3.00
AC XFMR – $1.50
Do not confuse with Non-Alarm kits sold by our competition! Eliminate the hassle – avoid the 5314!

WE MADE A FANTASTIC KIT EVEN BETTER. REDESIGNED TO TAKE ADVANTAGE OF THE LATEST ADVANCES IN I.C. CLOCK TECHNOLOGY. FEATURES: LITRONIX DUAL ½" DISPLAYS, MOSTEK 50250 SUPER CLOCK CHIP, SINGLE I.C. SEGMENT DRIVER, SCR DIGIT DRIVERS. GREATLY SIMPLIFIED CONSTRUCTION. MORE RELIABLE AND EASIER TO BUILD. KIT INCLUDES ALL NECESSARY PARTS (except case). P.C.B. OR XFMR OPTIONAL.
NEW! WITH JUMBO LED READOUTS!

MOTOROLA SCR
2N4443. 8 AMP 400 PIV.
P.C. Leads. $3/$1.00

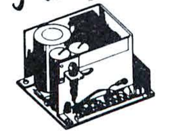
FAIRCHILD - TBA 641
4W. Audio power Amp. Just out! In special heat sink DIP. One super audio IC.
$1.50 with data

AC LINE FILTER
Rated 3 AMPS - 115/230V 50 to 400 HZ.
Noise Proof Your Computer
$3.00 each

GRAB BAG NUMBER 2
Mixed Motorola TO-18 case metal transistors. About 60% yield. PNP & NPN. Untested. A good assortment! 100 for $3.00

PRICES SHOWN SUBJECT TO CHANGE WITHOUT NOTICE.

Price Cut! ~~$15.95~~ **$12.**



COMPUTER POWER SUPPLY

A very fortunate purchase. One of the best industrial quality REGULATED supplies we have seen. High performance, small size. Input is 120VAC 60HZ. Has the following regulated outputs: –5VDC@800MA; –15VDC@1.25AMP; –25VDC@180MA. Sold at a fraction of original cost. Do yourself a favor and order NOW.

AMD – 1702A

Factory Prime Units – Brand New – 1.5 Micro-seconds Access Time. – $4.95 each
10 FOR $40. HUGE FACTORY DIRECT PURCHASE!

TERMS:

MONEY BACK GUARANTEE. NO COD's. TEXAS RESIDENTS ADD 5% SALES TAX. ADD 5% OF ORDER FOR POSTAGE & HANDLING. ORDERS UNDER $10.00 ADD 75c. FOREIGN ORDERS: U. S. FUNDS ONLY!

Call your Bankamericard or Master Charge order in on our continental United States toll free Watts:
1-800-527-3460
Texas Residents Call Collect:
214/271-0022

CHEAP DC SUPPLY
Actually an AC adapter for calculators. 9VDC-no load. 6VDC@200MA. 4VDC@375MA
$2. ea.

S.D. SALES CO.
P.O. BOX 28810 – E
DALLAS, TEXAS 75228

Orders over $15. - Choose $1. FREE MERCHANDISE!

FIFO FLEA MARKET

HELLO PARTY: I am interested in exchanging development/marketing ideas etc., relating to mini/microcomputers for the small business or home applications. You may call (collect) Emil C. Rotar (215) 272-1400.

FOR SALE: Video Data Terminal Model 70/752 12" screen, 20 lines x 54 characters. Full editing capability & cursor control incl. Data Insert. Output: RS232, 1,200 baud, ASCII. Self-contained Pwr. Sply., timing clock, and 2 I/O boards. ASCII Keyboard included. Also schematics, specs, etc. $600 or offer. Dick Blayney, 12241 Laurianne Ln., Garden Grove, CA 92641.

FOR SALE: Polymorphic, Poly-88 computer, $480. Seals 8KSC-Z, 8K-hi speed memory board, $250. Several IMSAI boards, Tarbell, & Polymorphic boards. Call (213) 477-8478 for details, or send self addressed stamped envelope to Roger Lewis, 14777 Barrington #17, Los Angeles, CA 90025.

HELP! My circuits are still too large. I tried everything save one . . . where can I get CD4000-SN7400 and/or Linear I.C.s in FLAT PACKs?! Larry Walker, 2415 Williamsbridge Rd., Bronx, N.Y. 10469.

FOR SALE: VIDEO TERMINAL & KEYBOARD Hazeltine/Basic Four, 80 characters x 24 lines, full ASCII keyboard, selectable baud rates, extra interfaces for tape cassette, printer, remote monitor. Core memory, background/foreground, batch + full/half duplex. This is a professional unit, sold new for over $3000. Best offer. Pete Skye (213) 980-9490, 10700 Ventura Blvd., No. Hollywood, CA 91604.

FOR SALE: Burroughs L-2000 Computer System. Includes Burroughs TC-500 computer converted (by Burroughs technicians) to L-2000 computer, Burroughs Style 595 80-Column Card Reader, Burroughs Style A-149 Card Punch, 80 Column. Total Price $4,000. This does not include Software which must be purchased from Burroughs Inc. Call or Write James E. Howard, P.O. Box 725, Pocatello, Idaho 83201. (208) 232-1101.

PRIVACY, CRYPTOGRAPHY, SECURITY. Tutorial book, 6603 computer compiled ciphering algorithms, demonstration cipher systems. $13.25. Clay Pierce, Box 4747, Saticoy, CA 93003.

FOR SALE: Mini-micro designer by E & L Instru., fully assembled, good working condition. Used for 6 mos., priced at $300. Manual & Bugbook I (6 units) included along with Intel 8080 user's manual & vol. 1 of an introduction to computers by OA. Call (805) 522-5276 after 6 p.m. James Chen.

FOR SALE: NEW UNIVAC 30cps 132 column 64 character printer with drive electronics board and motor (NEW), also sturdy Univac case and stand (used), with documentation and interface into, cost $1800+, sacrifice $695. D. Krivoshik, 18 Newcomb Pl., Elizabeth, NJ 07202.

FOR SALE: Factory-assembled 6800 microcomputer: CPU board with 1K EPROM (monitor, debug, assembler, editor), 4K RAM, ½ PIA; 16K RAM Memory board; Video interface board; I/O Serial board with audio KC standard and EPROM (load & dump); 9" TV Monitor; cassette recorder; PC wiring for TTY/RS232/modem; Manuals, schematics, documentation; software on cassettes includes Tiny Basic, mnemonic assembler, games & more. Price: $1800! Contact David Demorest, 12697 Graton Rd., Sebastopol, CA 95472, (707) 823-1698.

FOR SALE: 2-GSI 110 floppy disc drives. They are single or dual density, soft or hard sector drives. The electronics boards are fully optioned, including data separator. I have a complete set of documentation and all connectors and cables. Will sell for $350 ea. or $650 for the pair. Jim Baumgardt, 6343 Lincoln Ave., Apt. F-2, Buena Park, CA, (714) 826-7056.

FOR SALE: 8K-8080A SYSTEM Intel Bus. 8080A CPU with 6I/O ports, sockets for 3 more (add 1 chip), board set up for up to 3K PROM, 2-4K 450nsec static lowpower RAM, TVT III with 2K RAM, UART (Serial i/o), cursor control board, HITS cassette interface (space on board for bootstrap PROM), Hall effect ASCII keyboard 69 keys, 5A power supply and case and connectors for 64K, boards assembled with sockets, NEW NOT USED, backplane unassembled, full doc., first $975, write for more details: D. Krivoshik, 18 Newcomb Pl., Elizabeth, NJ 07202.

FOR SALE: SWTPC CT-1024 Terminal with 64 characters/line, scrolling, serial board, Power Supply, cursor board and memory. Completely assembled. No keyboard nor case, $200. MITS S10 w/one port, $125. Both items $300. Victor Chinn, 1618 Milviast, Berkeley, CA 94709 (415) 548-9697.

FOR SALE: IMSAI 8080, 22 slot m/brd, 24K memory, 3P+S interface, PIC-8 interrupt board, ASR33 TTY, Northstar floppy disc, fully operational. Software includes DOS, BASIC, and assembler. New cost $4500. Selling as a system, best offer. G. Young, P.O. Box 1532, Studio City, CA 91604, (213) 761-7388.

FOR SALE: ACT 4004/4040 complete computer on board with clock, CPU, and sockets for 16 RAM chips. Complete with documentation. $120. Bill Fuji, 1506 Sandcastle Dr., Corona del Mar, CA 92625.

WANTED: INTERFACE AGE Magazine Volume One, Numbers 1-12 and Volume 2, Numbers 2, 4. Also wanted BYTE Magazine Volume 1, Numbers 1-12 and Volume 2 Number 2. Please state condition and asking price. Michael I. Baruch, 1948-86th Street, Brooklyn, New York 11214.

FOR SALE: Enhancements for the IMSAI SCS-1 Editor Assembler: Have package which will add: 1. Resequencing of the current file on command; 2. Printing of the symbol table on command; 3. A new op code, 'ASC', which will allow an ASCII string constant of up to 30 characters to be defined per line of source code. Package is stored in memory locations 0E50-0FFF. No additional memory required. An INTEL checksum paper tape containing object code, a complete source listing, and complete documentation available for $7.50. James E. Bell, Jr., 491 Johannah Pl., Lilburn, GA 30247.

IBM SELECTRIC I/O's are cheaper on the European market. Various sources sell used machines overhauled and function tested for 220 V, 50 Hz. You need a transformer and the US 60 Hz will result in 20% more speed. I can offer such machines at 500 to 600 $ each (freight included, you'll have to wait about 4 weeks). Contact me with return postage (2 IRCs for airmail reply): S. Rambaum, Rossdoerfer 44, 6100 Darmstadt, W. Germany.

FOR SALE Altair 8800b $935, MITS 16K $800, 4PIO $110, Chromemco A-D $200, Dazzler $300, Bytesaver (1/2K) $250, National Multiplexer 2SIO $145, Nat Mult CC7 Recorder $125. Equipment professionally built and like new. Arnold Bob, 1325 43rd Street, Brooklyn, NY 11219.

FOR SALE: Complete factory assembled Sphere system: 6800 MPU, keyboard, CRT, power supply, resident monitor in PROM, 4K user memory, 2 cassette I/O. Asking $1000.00 or willing to trade for a 924 Porsche. Bob Wada (714) 893-8940

FOR SALE: Papertape equipment. Two highspeed Digitronics PT 8-level readers, 300 cps, stop on character, like new, $60 each. One 8-level papertape punch, including all drive electronics and interface to 8-bit micro, $75. Jim McCord, 120 E. De La Guerra, Santa Barbara, CA 93101. (805) 963-8941.

MICRO-MARKET

BUYING OR SELLING?
Let us quote your needs!
Whether you want to buy or sell,
We are a minicomputer brokerage.
We bring buyers and sellers together.

EXPERTISE *Agency*
Post Office Box 632V
Santa Ana, California 92702

Quote manufacturer, model, condition, age, new price, manuals, software, and selling price.

Introductory Offer

POLY-88	Sys 2	$550
IMSAI	22 Slot	$600
SEALS	8KSC-Z	$250

Check our prices on your needs. We will not be UNDERSOLD!

AAAA Computer How's
1477 Barrington, Suite 17
W. Los Angeles, CA 90025 (213) 477-8478

LONG ISLAND
IMSAI Dealer
COMPUTER MICROSYSTEMS
Kits • Parts • Service • Books • Magazines
1309 Northern Blvd., Manhasset, N.Y. 11030
Telephone (516) 627-3640

MARKET YOUR SOFTWARE
CALL OR WRITE
Microcomputer Software Depository
2361 E. Foothill Boulevard
Pasadena, California 91107
(213) 449-0616

S-100 PROTOTYPING CARD

- ☆ Space for 4 7805-type regulators
- ☆ Accepts all 14, 16, 24, 40 pin WW sockets
- ☆ Available with a kit of parts for Sargent's S-4 start up system
- ☆ Bare board $25.00 ppd. Plan set only $7.50 ppd.
- ☆ Complete kit of all parts $79.95 ppd. Software Cassette $7.50

Sargent's Distributing
4209 KNOXVILLE LAKEWOOD, CA 90713

ADM-3A

IN KIT FORM $825.00*

- All equipment F.O.B. Dallas, Texas or Anaheim, California
- Terms — check or money order with order
- Delivery in 30 days

OPTIONS:
- Lower case option add $100.00
- Numeric key pad option add $75.00

- 80 CHARACTERS/LINE
- 24 LINES/SCREEN
- ADDRESSABLE CURSUR
- 9, 10, or 11 BIT WORDS
- 75-19,200 BAUD
- FULL & HALF DUPLEX
- ODD/EVEN/NO PARITY
- RS232 INTERFACE OR 20 ma CURRENT LOOP

* Plus your applicable state sales tax

GET COMPLETE DETAILS WITH A DIRECT CALL:
214 258-2414 TWX 910-860-5761 TELEX 73-0022
800 527-3248

capital
equipment brokers
930 N. BELTLINE • IRVING, TEXAS 75061

OUT OF MEMORY — AGAIN?!
Another board-Another socket-More power & heat!
STOP!!
Get our 32K MEMORY on a SINGLE BOARD

- •Plug Compatible for Digital Groups Z-80 System
- •400 Nanosecond Access Time
- •Uses the Z-80's Refresh
- •Very Low System Power Requirements
- •64K Bytes Implemented with Only Two Boards

$295 - 8K Bytes assembled and tested
$ 90 - Each add'l 4K installed when Board purchased
$100 - Each add'l 4K installed separately
$ 90 - 4K Memory Kit for user installation

MICRO SYSTEMS ENGINEERING
P. O. Box 20271
Minneapolis, Minnesota 55420

ELIMINATE INTERFERENCE

Keep Power Line noise & transients out of your system. Bonus! No more TV, Stereo or Radio interference. Wires directly into computer, teletype, power supply. Postpaid.

ELF-3 $9.50 — 3 amp Line Filter
ELF-10 $12.50 — 10 amp Line Filter
Filter/Transient ELF/T-3 (3 amp) $14.25
Suppressor ELF/T-10 (10 amp) $17.25

ELECTRONIC SPECIALISTS, INC.
171 So. Main, Natrick, Mass 01760

A.D.M.
Communications, Inc.
Teletype & Communications Equipment
Buy—Sell—Recondition
1322 Industrial Ave.
Escondido, CA 92025
(714) 747-0374 Telex 695097

End your video display problems quickly with a "PIXE-VERTER"

A transistorized modulated oscillator which instantly converts a TV receiver into a top notch video monitor. Connects directly to antenna terminals. No wiring modifications required to the set. Operates on channels 2-6. Power requirements 5-6 volts @ 3 ma. Ideally suited for computers, electronic games, TV cameras, video recorders, etc. Size: 1.25" x 2.1". Kit model #PXV-2A $8.50. Order by phone or mail.

DIAL 402-987-3771

ATV Research 13-I BROADWAY DAKOTA CITY, NEBR. 68731

Computer Mart of New York Inc.
314 Fifth Ave. ★ New York, N.Y. 10001
Microcomputers, Books, Components, Parts
Authorized Dealer—Service—Friendly Advice
Closed Monday
Open 10-6 Tues.-Sat. 10-9 pm on Thurs.
STAN VEIT, Storekeeper
Telephone (212) 279-1048

---

21 SHOESTRING START-AT-HOME COMPUTER BUSINESSES

113 page research report uncovers areas never published. $12.00 (Check, Mastercharge, Bankamericard) Guaranteed Refundable.

DATASEARCH
730 Waukegan, Suite 108-F
Deerfield, IL 60015

SOUTH FLORIDA
Sunny Computer Stores, Inc.
Authorized Dealer:
IMSAI, Southwest, Cromemco, CSC, Vector and others
Books, Magazines, Newspapers, Service and Supplies
University Shopping Center
1238A South Dixie Highway
Coral Gables, Fla. 33146
(305) 661-6042

COMPUTER HOBBYISTS!
Nationwide Classified Advertising Newsletter
Buy & Sell Hardware & Software
new/used/unique/low-cost
$3.75 for 18 issues.
Free sample issue on request.
ON_LINE Newsletter
24695 Santa Cruz Hwy, Los Gatos, Ca. 95030

COMPUTER MAILING LIST

- Lists all Hobbyist Computer Dealers in USA, Foreign Countries, Hobbyist Manufacturers, and Clubs.
- One-half year subscription with complete monthly updates $75.
- Send for free sample page.
- Label printing service available.

MICRO APPLICATIONS
12000 Doral Avenue Northridge, CA 91326

SERIES **33 TTY's**
FOR SALE OR RENT

EXCLUSIVE VARDON STYLING
REDUCES OPERATING NOISE
50% OR MORE

	SALE	RENTAL
ASR		
VARDON STYLING	1136.00	45.50 mo
STANDARD STYLING	940.00	40.50 mo
KSR		
VARDON STYLING	875.00	40.50 mo
STANDARD STYLING	650.00	30.50 mo

OPTIONAL SPECIALS

w/Acoustic coupler	add $6 mo
W/Hard wire modem (2 wire)	add $6 mo
W/EIA RS-232	add $3 mo
W/D E C or Nova interface	add $4 mo
W/DDD Originate-Auto Answer modem	add $23 mo
W/TWX/DDD modem	add $25 mo

TERMS

1. Prices guaranteed for term of lease
2. All equipment F O B Dallas, Texas
3. All equipment unconditionally guaranteed for 30 days
4. Customer must provide maintenance after 30-day warranty period

GET COMPLETE DETAILS WITH A DIRECT CALL:
(214) 252-7502 • TWX 910-860-5761 • TELEX 73-0022

vardon & associates, inc.
930 N. Beltline Road ■ Irving, Texas 75061
A subsidiary of Pioneer Texas Corporation

ADD COLOR TO EXISTING TV GAMES WITH A "CHROMA-PLEX 7700" DIGITAL CHROMA MULTIPLEXER KIT!

EASILY ADAPTED TO MOST BLACK and WHITE GAMES. (i.e., General Instrument 6-game chip #AY-3-8500.) CMOS/MOS FET CIRCUITRY. LOW POWER REQUIREMENTS: 7.0 V reg. @ 25ma. 3-5/8" x 4" double-sided plated board. DOZENS OF COLOR COMBINATIONS POSSIBLE. VERY VERSATILE. EASILY ASSEMBLED IN ONE EVENING. $35.00 P.P. ORDER BY PHONE or MAIL. DIAL 402 987-3771.

ATV Research 13-I BROADWAY DAKOTA CITY, NE. 68731

PROTECT YOUR INVESTMENT
Cover your
Altair/Imsai/SWTPC Computer

Is your computer chassis open and collecting dust while you plug boards in and out trying new hardware configurations?

Our heavy vinyl cover will keep harmful dust and dirt out of your chassis and protect it from scratches and bangs. Specify make with order.

$6.25 plus .75 postage and handling

JOYSTICK KIT

Control: Games; Interactive Graphics; Cursor Positioning; Process Control

No expensive Analog Interface required. Connects directly to one (1) output line and two (2) input lines.

Joystick Kit (Model QB690)
$49.95 plus $1.00 postage

Send check or money order to:

QUBED³
P.O. Box 7104
West Trenton, N.J. 08628

THE COMPUTER CORNER
"Brains are our Business"

- ✓ IMSAI 8080, POLY-88, Processor Tech
- ✓ Books, Magazines, TTY Supplies, Brain Games

Hours: 10-6 pm daily & Sat.: Thurs. 10-9 pm
White Plains Mall, 200 Hamilton Ave.
WHITE PLAINS, NY 10601
Telephone: (914) 949-DATA

MICRO-MARKET AD RATE:
$25.00 per column inch. Max. 4 column inches per ad. Submit ads to Micro-Market Ads—INTERFACE Magazine, P.O. Box 1234, Cerritos, CA 90701.

ADVERTISING INDEX

Information Inquiry Number		Page
MANUFACTURERS		
1	A P Products	9
2	Artisan Electronics	83
3	Associated Electronics	22
4	Audio Engineering	11
5	Computer Hobbiest Hotline	62
6	Cleveland Institute	5
7	Comptek	78
18	Compu/Time	46
8	Continental Specialties	14
9	Cromemco	1
10	Data Sync	71
11	Digital Group	3
12	dilithium/Matrix	68
13	E & L Instruments	41
14	Electronic Control Technology	73
15	Electronic Product Associates	19
16	Franklin Electronics	63
	Hal Communications	86
25	Heathkit	3, 32, 33, 34
26,27	iCOM	42,43
	IMSAI	IBC
29,30	Intelligent Systems	6, 7
31	Lear Siegler	80, 81
32	Microdesign	73
33	Microdesigns, Inc.	21
34	Micromation	10
35	Midwest Scientific	59
36	Minicomps Supply	35
37,38	MiniTerm	8, 52
39,40,41	MITS	44, 45, 55
42	Motorola	13
43	MPI	20
44	National Multiplex	86
45	Objective Design	20
46	Ohio Scientific Instruments	37
47	OK Machine & Tool	65
48	Omni Systems	22
49	PAiA Electronics	62
50,51	Parasitic Engineering	62, 77
52	Peripheral Vision	51
53,54	Processor Technology	48, 49, 50
	Polymorphic Systems, Inc.	39
56	Quay Corporation	53
57	Sylvanhills Lab	78
58	Scientific Research	47
59	Sharp & Associates	87
60	SWTP	IFC
61	Technical Design Labs	BC
28	Technico, Inc.	69
62	Triple i	40
63	Ultra-Byte	84, 85
64	Urban Instrument	77
65	Vector Graphics	26
66,67	Wameco	35, 40
68	Xybek	77
COMPUTER STORES		
69,70	A-VIDD	94, 99
71	Bits & Bytes, Phoenix, AZ	119
72	Bits N Bytes, Fullerton, CA	118
73	Byte Shop, Inc.	122
74	Byte Shop, Long Beach, CA	114
75	Byte Shop, Long Island, N.Y.	88
76	Byte Shop, Miami, FL	119
77	Byte Shop, Pasadena, CA	101
78	Byte Shop, Columbia, SC	115
79	Byte Shop, Tempe, AZ	95
81	Computer Components	93
82	Computer Enterprises	114
83	Computer Machine Services	110
84	Computer Mart, NY	118
85	Computer Playground	109
86	Computer Store, Santa Monica, CA	125
87	Computer Warehouse	113
88	Disc 3	91
89	Metatec Corporation	126
90	Sunny Sounds	112
91	Sunshine Computer Company	121
92	Synchro-Sound	117
93	Tech-Mart	89
SURPLUS STORES		
94	Advanced Microcomputer Products	127
95	Atwood Enterprises	132
55	Byte Magazine	130
96	Digikey	139
97	Integrated Circuits Unlimited	135
98	Jade Company	129
99	Osborne & Associates	111
20	Personal Computing '77	58
100	Quest Electronics	100
101	S. D. Sales	141

CAST YOUR VOTE

The authors of this issue would like to know your feelings as to which article you consider the best. You may cast your vote on *only* one article. Select the best article and circle the corresponding number on the readership service card.

At the end of the voting period all votes will be tallied, the highest scoring article will be announced and the author will receive a $100 bonus.

Since we have recently changed computing services, please note the address change on the reader service card to: INTERFACE AGE Magazine, Box 2654, Clinton, Iowa 52732.

ARTICLE

401 A Microcomputer-Aided Prosthesis Control System
by Amos Freedy, John Lyman and Moshe Solomonow

402 A Microprocessor Control Prosthesis Via EMG Signal
by Daniel Graupe

403 HEXAPOD
by Robert B. McGhee and James R. Buckett

404 Microprogrammed Computers
by Oliver Holt

405 Introducing the S-100 Standard Small Computer Bus Structure
by W. M. Goble

406 Day of the Week
by Jim Huffman

408 Star Lanes
by Steven Faber

FEBRUARY WINNER: Legion: An Experiment in Artificial Intelligence by Marlin Ellers

MARCH WINNER: The Qube by Roger Garrett

READER SERVICE CARD ②

INTERFACE™

June 1977 Issue
Void after August 31, 1977
(Please type or Print)

Name ______________________

Title ______________________

Company ____________ Phone (A/C) ____________

Address ______________________ ☐ Home ☐ Business

City ____________ State ______ Country ______ Zip ______

ANSWER THE FOLLOWING BY CHECKING *ONE* BOX ONLY PER QUESTION.

1. I Am A
A. ☐ Professional (Medical, Accounting, Law, Etc.)
B. ☐ Engineer (Electronics, Mechanical Etc.)
C. ☐ Business Person (Retail, Wholesale, Etc.)
D. ☐ Educator (Professor, Teacher, Assistant, Etc.)
E. ☐ Student
F. ☐ Hobbyist
G. ☐ Other ____________

2. My Status Is
A. ☐ Have All Computing Equipment
B. ☐ Need More Peripherals
C. ☐ Have CPU Only
D. ☐ Have No Equipment
E. ☐ Other

3. I Need This Information For
A. ☐ Immediate Purchase
B. ☐ Purchase 30-60 Days
C. ☐ Comparisons
D. ☐ Literature Library
E. ☐ Other ____________

4. My Interest Emphasis Is
A. ☐ Hardware
B. ☐ Firmware
C. ☐ Software
D. ☐ Other ____________

5. My Application Is
A. ☐ Hobby Only
B. ☐ Business Only
C. ☐ Hobby & Business
D. ☐ Instruction Purposes
E. ☐ Research
F. ☐ Design & Development
G. ☐ Other ____________

6. My *Primary* Source Of "State-of-the-Art" Information Comes From:
A. ☐ Magazines
B. ☐ Exhibits & Conventions
C. ☐ Club Meetings
D. ☐ Direct Mail From Manufacturers
E. ☐ Other ____________

7. I prefer To Buy
A. ☐ Directly From Manufacturers
B. ☐ Local Computer Retailer (Store)
C. ☐ Mail Order
D. ☐ Club Group Purchases
E. ☐ Other ____________

8. I Look To *INTERFACE AGE* First For
A. ☐ New Product Information
B. ☐ Software Information
C. ☐ Tutorials
D. ☐ Hardware Articles
E. ☐ Product Advertising
F. ☐ Remarks ____________

Please send information on items circled below.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100
101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125
126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150
151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175
176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200
201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225
226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250
251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275
276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300
301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325
326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350
351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375
376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400

Please use only 1 card per person. Thanks!

READER SERVICE CARD ①

INTERFACE™

June 1977 Issue
Void after August 31, 1977
(Please type or print)

Name ______________________

Title ______________________

Company ____________ Phone (A/C) ____________

Address ______________________ ☐ Home ☐ Business

City ____________ State ______ Country ______ Zip ______

ANSWER THE FOLLOWING BY CHECKING *ONE* BOX ONLY PER QUESTION.

1. I Am A
A. ☐ Professional (Medical, Accounting, Law, Etc.)
B. ☐ Engineer (Electronics, Mechanical Etc.)
C. ☐ Business Person (Retail, Wholesale, Etc.)
D. ☐ Educator (Professor, Teacher, Assistant, Etc.)
E. ☐ Student
F. ☐ Hobbyist
G. ☐ Other ____________

2. My Status Is
A. ☐ Have All Computing Equipment
B. ☐ Need More Peripherals
C. ☐ Have CPU Only
D. ☐ Have No Equipment
E. ☐ Other

3. I Need This Information For
A. ☐ Immediate Purchase
B. ☐ Purchase 30-60 Days
C. ☐ Comparisons
D. ☐ Literature Library
E. ☐ Other ____________

4. My Interest Emphasis Is
A. ☐ Hardware
B. ☐ Firmware
C. ☐ Software
D. ☐ Other ____________

5. My Application Is
A. ☐ Hobby Only
B. ☐ Business Only
C. ☐ Hobby & Business
D. ☐ Instruction Purposes
E. ☐ Research
F. ☐ Design & Development
G. ☐ Other ____________

6. My *Primary* Source Of "State-of-the-Art" Information Comes From:
A. ☐ Magazines
B. ☐ Exhibits & Conventions
C. ☐ Club Meetings
D. ☐ Direct Mail From Manufacturers
E. ☐ Other ____________

7. I prefer To Buy
A. ☐ Directly From Manufacturers
B. ☐ Local Computer Retailer (Store)
C. ☐ Mail Order
D. ☐ Club Group Purchases
E. ☐ Other ____________

8. I Look To *INTERFACE AGE* First For
A. ☐ New Product Information
B. ☐ Software Information
C. ☐ Tutorials
D. ☐ Hardware Articles
E. ☐ Product Advertising
F. ☐ Remarks ____________

Please send information on items circled below.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100
101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125
126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150
151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175
176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200
201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225
226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250
251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275
276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300
301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325
326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350
351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375
376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400

Please use only 1 card per person. Thanks!

READER SERVICE CARD

SUBSCRIPTION

SUBSCRIPTION APPLICATION FORM

PAYMENT MUST ACCOMPANY FORM

SUBSCRIPTION FEE per year: $10.00 U.S., $12.00 Canada/Mexico, $18.00 Foreign.
Must be in U.S. funds drawn on a U.S. bank.

Make check payable to: **INTERFACE™ Magazine**
P.O. Box 1234, Cerritos, CA 90701

Name ______________________ Title ____________

Company ______________________

Home Address ______________________

City ____________ State ______ Country ______ Zip ______

Date ____________ Signature ______________________

☐ CHECK ☐ MONEY ORDER ☐ BANKAMERICARD ☐ master charge

Account # ____________ Expires ____________

PLANNING TO MOVE?

Let us know 8 weeks in advance so that you won't miss a single issue of/INTERFACE.

Attach old label where indicated and print new address in space provided. Also include your mailing label whenever you write concerning your subscription. It helps us serve you promptly.

If you have no label handy, print OLD address here.

Please Print

Name

Company

Address

City State Zip code

Affix Label **Print NEW address here**

Name

Company

Address

City State Zip code

MAIL COMPLETED CARD TO:

INTERFACE™ **Magazine**
P.O. Box 1234
Cerritos, California 90701

MOVING

First Class
Permit No. 217
Clinton, Iowa

BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

Postage will be paid by

INTERFACE™ **Magazine**

Box 2654

Clinton, Iowa 52732

First Class
Permit No. 217
Clinton, Iowa

BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

Postage will be paid by

INTERFACE™ **Magazine**

Box 2654

Clinton, Iowa 52732


XiTAN
TECHNICAL
DESIGN
LABS